

# PROJECT MANUAL

## Davis Sr HS Aquatic Center

315 W. 14<sup>th</sup> Street  
Davis, CA 95616

### DSA Final (CD)

Developed For:  
**Davis Joint Unified School District**  
526 B Street  
Davis, CA 95616

### Volume 1 of 1

Divisions 01-33  
LPA Project No. 19044.13  
DSA Application #02-119490  
November 1, 2021

**LPA**



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431 I Street, Suite 107  
Sacramento, California 95814

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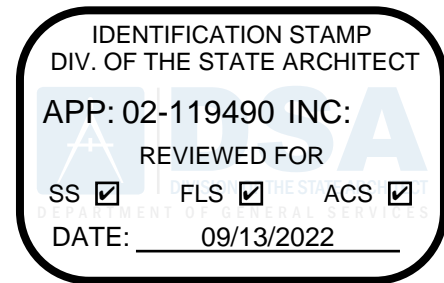
## SECTION 000002 - PROJECT DIRECTORY

Owner:

**Davis Joint Unified School District**  
526 B Street  
Davis, CA 95616  
T- 530-757-5300

Contact:

David Burke  
Executive Director of Capital Operations

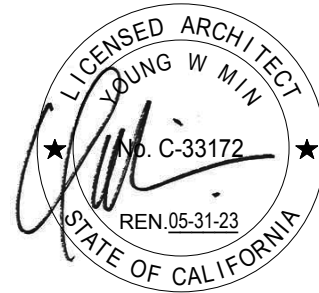


Architect:

**LPA, INC.**  
5301 California Ave, Suite 100  
Irvine, CA 92617  
T- 949.701.4209  
F- 949.260.1190

Contact:

Young Min, AIA, #33172  
Architect of Record



Civil Engineer:

**LPA, INC.**  
5301 California Ave, Suite 100  
Irvine, CA 92617  
T- 949.701.4033  
F- 949.260.1190

Contact:

Kathereen Shinkai, RCE #68369  
Civil Engineer of Record



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Landscape Architect:

**LPA, INC.**

431 I Street, Suite 107  
Sacramento CA 95814  
T- 916.287.2400  
F- 916.772.4330

Contact:

John Courtney, ASLA #4476  
Landscape Architect of Record



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Structural Engineer:

**LPA, INC.**

5301 California Ave, Suite 100  
Irvine, CA 92617  
T- 949.701.4209  
F- 949.260.1190

Contact:

Daniel Wang, P.E., S4453  
Structural Engineer of Record



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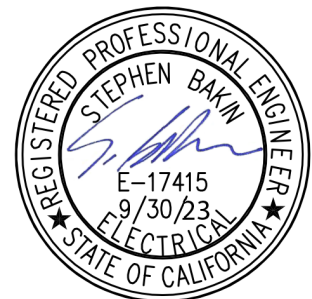
Electrical Engineer:

**LPA, INC.**

5301 California Ave, Suite 100  
Irvine, CA 92617  
T- 949.701.4209  
F- 949.260.1190

Contact:

Steve Bakin, #E-17415  
Electrical Engineer of Record



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Mechanical Engineer:

**LPA, INC.**

5301 California Ave, Suite 100  
Irvine, CA 92617  
T- 949.701.4279  
F- 949.260.1190

Contact:  
Christopher Tindall, #M32973  
Mechanical Engineer of Record



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Fire Suppression Engineer:

**LP Consulting Engineers, Inc.**

1209 Pleasant Grove Blvd.  
Roseville, CA 95678  
T- 916.771.0778  
F- 916.783.9446

Contact:  
Sean Pourvakil, PE #M32311  
Fire Suppression Engineer of Record



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NOT USED

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NOT USED

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NOT USED

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## SECTION 01 1000 SUMMARY

### PART 1 GENERAL

#### 1.01 PROJECT

- A. Project Name: Davis Sr HS Aquatic Center
- B. Owner's Name: Davis Joint Union School District
- C. Architect's Name: LPA, Inc..
- D. Additional Project contact information is specified in Section 00 0103 - Project Directory.
- E. The Project consists of the construction of Swimming Pool, Fencing, Pool Deck, Mechanical Building, Restrooms Building and Site Improvements.

#### 1.02 CONTRACT DESCRIPTION

- A. Contract Type: Lease-Leaseback based on a Stipulated Price as described in Document 00 5000 - Contracting Forms and Supplements.

#### 1.03 DESCRIPTION OF ALTERATIONS WORK

- A. Scope of demolition and removal work is indicated on drawings and specified in Section 02 4100.
- B. Scope of alterations work is indicated on drawings.

#### 1.04 WORK BY OWNER

- A. Owner will supply and install the following:
- B. Owner will supply the following for installation by Contractor:

#### 1.05 OWNER OCCUPANCY

- A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.
- B. Owner intends to occupy the Project upon Substantial Completion.
- C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- D. Schedule the Work to accommodate Owner occupancy.

#### 1.06 CONTRACTOR USE OF SITE AND PREMISES

- A. Provide access to and from site as required by law and by Owner:
  - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
  - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- B. Controlled Substances: Use of tobacco products and other controlled substances within the existing building is not permitted.

#### 1.07 WORK SEQUENCE

### PART 2 PRODUCTS - NOT USED

### PART 3 EXECUTION - NOT USED

**END OF SECTION 01 1000**

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**SECTION 01 2000  
PRICE AND PAYMENT PROCEDURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Procedures for preparation and submittal of applications for progress payments.

**1.02 SCHEDULE OF VALUES**

- A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- B. Forms filled out by hand will not be accepted.

**1.03 APPLICATIONS FOR PROGRESS PAYMENTS**

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. Execute certification by signature of authorized officer.
- E. Submit three notarized copies of each Application for Payment.

**END OF SECTION 01 2000**

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## SECTION 01 2100 ALLOWANCES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Owner Contingency allowance.

#### 1.02 CONTINGENCY ALLOWANCE

- A. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Owner Contingency Allowance.
- B. Funds will be drawn from the Owner Contingency Allowance only with Owner authorization via Change Order.
- C. At closeout of Contract, funds remaining in Owner Contingency Allowance will be credited to Owner by Change Order.

#### 1.03 ALLOWANCES SCHEDULE

- A. Owner Contingency Allowance: Include the stipulated sum/price of \$700,000 (Seven hundred thousand dollars) for use upon Owner's instructions.

### PART 2 PRODUCTS - NOT USED

### PART 3 EXECUTION - NOT USED

**END OF SECTION 01 2100**

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## SECTION 01 2300 ALTERNATES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Description of Alternates.

#### 1.02 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.

#### 1.03 SCHEDULE OF ALTERNATES

- A. Additive Alternate No. 1 - Sports light poles (Musco lights), related electrical wiring from site location to building.

### PART 2 PRODUCTS - NOT USED

### PART 3 EXECUTION - NOT USED

**END OF SECTION 01 2300**

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## SECTION 01 2500 SUBSTITUTION PROCEDURES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

#### 1.02 RELATED REQUIREMENTS

- A. Section 00 2113 - Instructions to Bidders: Restrictions on timing of substitution requests.
- B. Section 012500.01 Substitution Request Form A - Pre Bid. Required form for substitution requests made prior to award of contract (During procurement).
- C. Section 012500.02 Substitution Request Form B - Post Bid. Required form for substitution requests made after award of contract (During construction).
- D. Section 01 2300 - Alternates, for product alternatives affecting this section.
- E. Section 01 3000 - Administrative Requirements: Submittal procedures, coordination.
- F. Section 01 6000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

#### 1.03 DEFINITIONS

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

### PART 2 PRODUCTS - NOT USED

### PART 3 EXECUTION

#### 3.01 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
  - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
  - 2. Agrees to provide the same warranty for the substitution as for the specified product.
  - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
  - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
  - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
  - 6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
- B. A Substitution Request for specified installer constitutes a representation that the submitter:
  - 1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.
- C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
  - 1. Note explicitly any non-compliant characteristics.

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- D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
  - 1. Forms indicated in the Project Manual are adequate for this purpose, and must be used.
- E. Limit each request to a single proposed substitution item.
  - 1. Submit an electronic document, combining the request form with supporting data into single document.
- F. All substitutions and Requests for Information (RFI's) that affect Structural Safety, Fire and Life Safety, Access Compliance or Energy (as applicable) shall be submitted to the Division of the State Architect (DSA) for review and approval.

### **3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT**

- A. Instructions to Bidders specifies time restrictions for submitting requests for substitutions during the bidding period, and the documents required.
- B. Submittal Form (before award of contract):Form 'A' 012500.01

### **3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION**

- A. Submittal Form (after award of contract):Form 'B' 012500.02
- B. Architect will consider requests for substitutions only within 15 days after date of Agreement.
- C. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- D. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
  - 1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
  - 2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
  - 3. Bear the costs engendered by proposed substitution of:
    - a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
- E. Substitutions will not be considered under one or more of the following circumstances:
  - 1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
  - 2. Without a separate written request.
  - 3. When acceptance will require revisions to the Contract Documents.

### **3.04 RESOLUTION**

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Architect will notify Contractor in writing of decision to accept or reject request.
  - 1. Architect's decision following review of proposed substitution will be noted on the submitted form.

### **3.05 CLOSEOUT ACTIVITIES**

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

**END OF SECTION 01 2500**

**SUBSTITUTION REQUEST - FORM "A"**  
- For use during BIDDING period -



<b>Project Name:</b>		<b>Job No.</b>	
		<b>Date:</b>	
<b>To: Architect:</b> LPA, Inc.	<b>Contractor:</b>		
<b>Specified Item:</b>			
<b>Specification Section</b>	<b>Paragraph No.</b>	<b>Drawing No.</b>	<b>Detail No.</b>
<b>Contractor's Proposed Substitution:</b>			
<b>Reason For Request:</b> _____ _____			
<b>Manufacturer:</b> _____			
<b>Manufacturer Contact:</b> _____			
<b>Manufacturer Telephone:</b> _____			
<b>Trade Name and Model:</b> _____			
<b>History:</b> <input type="checkbox"/> New Product <input type="checkbox"/> 1-4 years in market <input type="checkbox"/> 5-10 years in market <input type="checkbox"/> over 11 years in market			
<b>Mandatory for Consideration: Specification Section 012500– Substitution Procedures</b>			
<input type="checkbox"/> Drawings <input type="checkbox"/> Product Data <input type="checkbox"/> Samples <input type="checkbox"/> Test Data <input type="checkbox"/> Reports <input type="checkbox"/> Other _____			
Attach a <b>Point-by-Point Comparison</b> between proposed product and product indicated. Provide complete data for proposed product, including product / material descriptions, specifications, drawings, photographs, performance, MSDS data sheet and test data adequate for evaluation of the request. Clearly annotate applicable portions of the data. Include ICC Evaluation Service (ICC ES) Evaluation Report, if applicable.			
The Undersigned certifies: - Proposed substitution has been fully investigated and determined to be equivalent or superior in all respects to specified product. - Proposed substitution complies with applicable Codes, ordinances and standards. - Proposed substitution complies with Contract requirements. - Same warranty will be furnished for proposed substitution as for specified products. - Same maintenance service and source of replacement parts, as applicable, are available. - Proposed substitution will have no adverse effect on related Work and will not affect or delay progress of the Work. - Proposed substitution does not affect dimensions and functional clearances. - Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.			
<b>Submitted by: (name)</b> _____		<b>Title:</b> _____	
<b>Signed:</b> _____		<b>Date:</b> _____	

**SUBSTITUTION REQUEST - FORM "A"**  
- For use during BIDDING period -



**Architect's Recommended Action:**

- ☐ **Approved.** Refer to Addendum # \_\_\_\_\_
- ☐ **Approved As Noted.** Refer to Addendum # \_\_\_\_\_
- ☐ Proposed substitution SUBJECT to receive approval by Division of the State Architect (DSA) for compliance with applicable provisions of California Code of Regulations (CCR), Title 24 of the California Building Standards Code (CBSC).
- ☐ **Rejected - Use specified product / materials.**
- ☐ **Request received too late - Use specified product / materials.**
- ☐ **Request does not have DSA approval - Use specified product / materials.**

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Remarks: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**SUBSTITUTION REQUEST - FORM "B"**  
- For use AFTER execution of Contract -



<b>Project Name:</b> Davis Sr HS Aquatic Center		<b>LPA Inc. Job No.</b> 19044.13	
		<b>Substitution No.</b>	
<b>To: LPA Inc.</b>		<b>Contractor:</b>	
<b>Specified Item:</b>			
<b>Specification Section</b>	<b>Paragraph No.</b>	<b>Drawing No.</b>	<b>Detail No.</b>
<b>Contractor's Proposed Substitution:</b>			
<b>Reason For Request:</b> _____  			
<b>Manufacture:</b> _____			
<b>Manufacturer Contact:</b> _____			
<b>Manufacturer and Telephone:</b> _____			
<b>Trade Name and Model:</b> _____			
<b>Mandatory for Consideration:</b> (Specification Section 012500 – Substitution Procedures)			
<input type="checkbox"/> Drawings <input type="checkbox"/> Product Data <input type="checkbox"/> Samples <input type="checkbox"/> Test Data <input type="checkbox"/> Reports <input type="checkbox"/> Other _____			
Attach a <b>Point-by-Point comparison against detailed and specified products</b> with complete data, including product / material descriptions, specifications, drawings, photographs, performance, MSDS data sheet and test data adequate for evaluation of the request. Clearly annotate applicable portions of the data. Include ICC Evaluation Service (ICC ES) Evaluation Report, if applicable.			
The Undersigned certifies: - Proposed substitution has been fully investigated and determined to be equivalent or superior in all respects to specified product. - Proposed substitution complies with applicable Codes, ordinances and standards. - Same warranty will be furnished for proposed substitution as for specified products. - Same maintenance service and source of replacement parts, as applicable, are available. - Proposed substitution will have no adverse effect on related Work and will not affect or delay progress of the Work. - Proposed substitution does not affect dimensions and functional clearances. - Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.			
<b>Submitted by: (name)</b> _____		<b>Title:</b> _____	
<b>Signed:</b> _____		<b>Date:</b> _____	

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**Architect's Recommended Action:**

- ☐ **Approved.** Refer to Change Order #\_\_\_\_\_
- ☐ **Approved As Noted.** Refer to Change Order # \_\_\_\_\_
- ☐ **Rejected - Use specified product / materials.**

**Name:**\_\_\_\_\_ **Date:**\_\_\_\_\_

**Remarks:**\_\_\_\_\_

\_\_\_\_\_

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## SECTION 01 3000 ADMINISTRATIVE REQUIREMENTS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. General administrative requirements.
- B. Electronic document submittal service.
- C. Preconstruction meeting.
- D. Site mobilization meeting.
- E. Progress meetings.
- F. Construction progress schedule.
- G. Contractor's daily reports.
- H. Progress photographs.
- I. Coordination drawings.
- J. Submittals for review, information, and project closeout.
- K. Number of copies of submittals.
- L. Requests for Interpretation (RFI) procedures.
- M. Submittal procedures.

#### 1.02 RELATED REQUIREMENTS

- A. Section 01 6000 - Product Requirements: General product requirements.
- B. Section 01 7800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

#### 1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 01 7000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
- B. Make the following types of submittals to Architect:
  - 1. Requests for Interpretation (RFI).
  - 2. Requests for substitution.
  - 3. Shop drawings, product data, and samples.
  - 4. Test and inspection reports.
  - 5. Design data.
  - 6. Manufacturer's instructions and field reports.
  - 7. Applications for payment and change order requests.
  - 8. Progress schedules.
  - 9. Coordination drawings.
  - 10. Correction Punch List and Final Correction Punch List for Substantial Completion.
  - 11. Closeout submittals.
- C. Supplementary Conditions:
  - 1. Compliance with Title 24, for Parts 1-6 and 9.
  - 2. Addenda must be signed by Architect and approved by DSA.
  - 3. Title 24, Part 1, California Administrative Code Chapter 5, Section 5-110 Written Approval (a): No changes or revisions shall be made following written approval which affects access compliance items unless such change or revisions are submitted to DSA for approval.
  - 4. Substitutions affecting DSA regulated items shall be submitted as a Construction Change Document (CCD) or Addenda, and shall be approved by DSA prior to fabrication and installation. (IR A-6).

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5. A CCD must be signed by the following;
  - a. Architect or Engineer of Record
  - b. Structural Engineer (when applicable)
  - c. Delegated Professional Engineer (when applicable)
  - d. District
  - e. Division of the State Architect (DSA)

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE**

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
  1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
  2. Contractor and Architect are required to use this service.
  3. It is Contractor's responsibility to submit documents in allowable format.
  4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
  5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, [www.adobe.com](http://www.adobe.com), or Bluebeam PDF Revu, [www.bluebeam.com](http://www.bluebeam.com)), unless such software capability is provided by the service provider.
  6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
  7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Submittal Service: The selected service is:
  1. Newforma Project Cloud: [www.newformaprojectcloud.com/#sle](http://www.newformaprojectcloud.com/#sle).
- C. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

### **3.02 PRECONSTRUCTION MEETING**

- A. Owner will schedule a meeting after Notice of Award.
- B. Attendance Required:
  1. Owner.
  2. Architect.
  3. Contractor.
  4. Inspector of Record.
- C. Agenda:
  1. Execution of Owner-Contractor Agreement.
  2. Submission of executed bonds and insurance certificates.
  3. Distribution of Contract Documents.
  4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
  5. Submission of initial Submittal schedule.
  6. Designation of personnel representing the parties to Contract.

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7. Procedures and processing of field decisions, RFIs, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
  8. Scheduling.
  9. Labor law requirements, including payment and reporting requirements.
- D. Record minutes and distribute copies within five days after meeting to participants, with copies to Architect, Architect, participants, and those affected by decisions made.

### **3.03 SITE MOBILIZATION MEETING**

- A. Owner will schedule meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required:
1. Contractor.
  2. Owner.
  3. Architect.
  4. Contractor's superintendent.
  5. Major subcontractors.
  6. Inspector of Record.
- C. Agenda:
1. Use of premises by Owner and Contractor.
  2. Owner's requirements.
  3. Work hours.
  4. Construction facilities and controls provided by Owner.
  5. Temporary utilities provided by Owner.
  6. Survey and building layout.
  7. Procedures for moisture and mold control.
  8. Procedures for disruptions and shutdowns.
  9. Construction waste management and recycling.
  10. Parking availability.
  11. Office, work, and storage areas.
  12. Equipment deliveries and priorities.
  13. Security and housekeeping procedures.
  14. Schedules.
  15. Application for payment procedures.
  16. Procedures for testing.
  17. Procedures for maintaining record documents.
  18. Requirements for start-up of equipment.
  19. Inspection and acceptance of equipment put into service during construction period.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

### **3.04 PROGRESS MEETINGS**

- A. Schedule and administer meetings throughout progress of the work at maximum weekly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required:
1. Contractor.
  2. Owner.
  3. Architect.
  4. Contractor's superintendent.
  5. Major subcontractors.
  6. Inspector of Record.
- D. Agenda:

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1. Review minutes of previous meetings.
  2. Review of work progress.
  3. Field observations, problems, and decisions.
  4. Identification of problems that impede, or will impede, planned progress.
  5. Review of submittals schedule and status of submittals.
  6. Review of RFIs log and status of responses.
  7. Review of off-site fabrication and delivery schedules.
  8. Maintenance of progress schedule.
  9. Corrective measures to regain projected schedules.
  10. Planned progress during succeeding work period.
  11. Maintenance of quality and work standards.
  12. Effect of proposed changes on progress schedule and coordination.
  13. Other business relating to work.
- E. Record minutes and distribute copies within five days after meeting to participants, with copies to Architect, Architect, participants, and those affected by decisions made.

### **3.05 PROJECT CLOSEOUT CONFERENCE**

- A. Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    - a. Preparation of record documents.
    - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    - c. Submittal of written warranties.
    - d. Coordination of separate contracts.
    - e. Installation of Owner's furniture, fixtures, and equipment.
    - f. Responsibility for removing temporary facilities and controls.
  4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

### **3.06 CONSTRUCTION PROGRESS SCHEDULE - SEE SECTION 01 3216**

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

### **3.07 DAILY CONSTRUCTION REPORTS**

- A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.
- B. Prepare a daily construction report recording the following information concerning events at Project site and project progress:

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1. Date.
2. High and low temperatures, and general weather conditions.
3. List of subcontractors at Project site.
4. Approximate count of personnel at Project site.
  - a. Include a breakdown for supervisors, laborers, journeymen, equipment operators, and helpers.
5. Major equipment at Project site.
6. Material deliveries.
7. Safety, environmental, or industrial relations incidents.
8. Meetings and significant decisions.
9. Unusual events (submit a separate special report).
10. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
11. Testing and/or inspections performed.
12. Signature of Contractor's authorized representative.

### **3.08 COORDINATION DRAWINGS**

- A. Review drawings prior to submission to Architect.

### **3.09 REQUESTS FOR INTERPRETATION (RFI)**

- A. Definition: A request seeking one of the following:
  1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in the Contract Documents.
  2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.
- C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of the Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
  1. Prepare a separate RFI for each specific item.
    - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
    - b. Do not forward requests which solely require internal coordination between subcontractors.
  2. Prepare using software provided by the Electronic Document Submittal Service.
  3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
- D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
  1. Include in each request Contractor's signature attesting to good faith effort to determine from the Contract Documents information requiring interpretation.
  2. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
    - a. Approval of submittals (use procedures specified elsewhere in this section).
    - b. Approval of substitutions (see Section - 01 6000 - Product Requirements)
    - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
    - d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).

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3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, the Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
  - a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.
- E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
  1. Official Project name and number, and any additional required identifiers established in Contract Documents.
  2. Owner's, Architect's, and Contractor's names.
  3. Discrete and consecutive RFI number, and descriptive subject/title.
  4. Issue date, and requested reply date.
  5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
  6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
  7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
  1. Indicate current status of every RFI. Update log promptly and on a regular basis.
  2. Note dates of when each request is made, and when a response is received.
  3. Highlight items requiring priority or expedited response.
- H. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
- I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
  1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
  2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
  3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
  4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.
- J. Digital File Naming: All RFIs shall be label by RFI number, followed by description. Any revision or supplement RFI relating to existing RFI shall be numbered with a file extension. IE.: 001-subject name.pdf, 001.1-subject name.pdf., 002-subject name.pdf, etc.

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### **3.10 SUBMITTAL SCHEDULE**

- A. Submit to Architect for review a schedule for submittals in tabular format.
  - 1. Submit at the same time as the preliminary schedule specified in Section - 01 3216 - Construction Progress Schedule.
  - 2. Coordinate with Contractor's construction schedule and schedule of values.
  - 3. Format schedule to allow tracking of status of submittals throughout duration of construction.
  - 4. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
  - 5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
    - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

### **3.11 SUBMITTALS FOR REVIEW**

### **3.12 SUBMITTALS FOR INFORMATION**

### **3.13 SUBMITTALS FOR PROJECT CLOSEOUT**

### **3.14 NUMBER OF COPIES OF SUBMITTALS**

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

### **3.15 SUBMITTAL PROCEDURES**

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

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12. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
13. Submittals not requested will be recognized, and will be returned "Not Reviewed",
- B. Product Data Procedures:
  1. Submit only information required by individual specification sections.
  2. Collect required information into a single submittal.
  3. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
  1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related work.
  2. Do not reproduce the Contract Documents to create shop drawings. Reproductions of Contract Documents will be rejected and returned without review.
  3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- D. Samples Procedures:
  1. Transmit related items together as single package.
  2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
- E. Coordinate preparation and processing of submittals with performance of construction activities.
  1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- F. Submittal number or other unique identifier, including revision identifier.
  1. Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
- G. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

### **3.16 SUBMITTAL REVIEW**

- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
- D. Architect's and consultants' actions on items submitted for review:
  1. Acknowledging contractor's intent for purchasing, fabrication, delivery, and installation:
    - a. "Reviewed", or language with same legal meaning.
    - b. "Reviewed as noted (resubmission is not required)", or language with same legal meaning.
      - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
    - c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
  2. Not Authorizing fabrication, delivery, and installation:
    - a. "Revise and Resubmit".
      - 1) Resubmit revised item, with review notations acknowledged and incorporated.

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- 2) Non-responsive resubmittals may be rejected.
  - b. "Rejected".
    - 1) Submit item complying with requirements of Contract Documents.
- E. Architect's and consultants' actions on items submitted for information:
  - 1. Items for which no action was taken:
    - a. "Received" - to notify the Contractor that the submittal has been received for record only.
  - 2. Items for which action was taken:
    - a. "Reviewed" - no further action is required from Contractor.

**END OF SECTION 01 3000**

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## REQUEST FOR INTERPRETATION



<b>Project Name:</b> Davis Sr HS Aquatic Center		<b>LPA Inc. Job No.</b> 19044.13	
		<b>RFI No.</b>	
<b>To: LPA Inc.</b> 431 I Street, Suite 107 Sacramento CA 95814		<b>Contractor:</b>	
<b>Subject:</b>			
<b>Specified Section</b>	<b>Paragraph No.</b>	<b>Drawing No.</b>	<b>Detail No.</b>
<b>Category:</b> <input type="checkbox"/> Need for Clarification <input type="checkbox"/> Unforeseen Condition <input type="checkbox"/> Conflict Within Documents		<input type="checkbox"/> Coordination Problem <input type="checkbox"/> Other	
<b>Description:</b>			
<b>Contractor's Proposed Resolution:</b>			
<input type="checkbox"/> Attachments: <input type="checkbox"/> Cost Impact: \$                      (Estimated) <input type="checkbox"/> Time Impact:			
<b>Contractor Signature</b>			<b>Date:</b>
<b>Architect's Response:</b>			
<input type="checkbox"/> Attachments:			
<b>Architect Signature:</b>			<b>Date:</b>

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## SUBMITTAL COVER SHEET



<b>Project Name:</b> Davis Sr HS Aquatic Center  <b>LPA Inc. Job No.</b> 19044.13	<b>Resubmittal</b>  <input type="checkbox"/> YES  <i>Add "letter" to original number</i>	<b>Submittal No.</b>  		
<b>SUBCONTRACTOR:</b>  <b>Name:</b>  <b>Address:</b>  <b>Telephone:</b>  <b>Contact:</b>	<b>CONTRACTOR:</b>  <b>Name:</b>  <b>Signed:</b>  <b>Dated:</b>  I hereby certify that I have reviewed the attached, have verified field requirements and compliance with the Contract Documents.			
<b>Submittal Description:</b>  		<b>Specification Section:</b>  		
<b>Date Received from Contractor:</b>  	<b>Distribution Date:</b>  			
<b>Consultant Review:</b>  <input type="checkbox"/> Civil <input type="checkbox"/> Electrical <input type="checkbox"/> Mechanical <input type="checkbox"/> Structural <input type="checkbox"/> Other:  <b>Date sent to consultant:</b>  <b>Date received from consultant:</b>	<b>Copies:</b>  <input type="checkbox"/> Contractor  <input type="checkbox"/> Inspector  <input type="checkbox"/> LPA File  <input type="checkbox"/> Owner  <input type="checkbox"/> Other: _____			
Review and commentary noted below are only for general conformance with (1) the design concept of the project and (2) the information given in the contract documents and for no other purpose. Commentary below is subject to the requirements of the contract documents. The Contractor is not relieved from responsibility for any deviation from the requirements of the contract documents, errors or omissions in drawings, calculations or samples, confirmation and correlation of dimensions at the job site, fabrication process and techniques of construction, coordination of his work with that of all other trades and satisfactory performance of his work.				
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> <input type="checkbox"/> <b>REVIEWED</b>   <input type="checkbox"/> <b>FURNISH AS CORRECTED</b>   <input type="checkbox"/> <b>REVISE &amp; RESUBMIT</b> </td> <td style="width: 50%; vertical-align: top;"> <input type="checkbox"/> <b>SUBMIT SPECIFIC ITEM</b>   <input type="checkbox"/> <b>REJECTED</b> </td> </tr> </table>			<input type="checkbox"/> <b>REVIEWED</b>  <input type="checkbox"/> <b>FURNISH AS CORRECTED</b>  <input type="checkbox"/> <b>REVISE &amp; RESUBMIT</b>	<input type="checkbox"/> <b>SUBMIT SPECIFIC ITEM</b>  <input type="checkbox"/> <b>REJECTED</b>
<input type="checkbox"/> <b>REVIEWED</b>  <input type="checkbox"/> <b>FURNISH AS CORRECTED</b>  <input type="checkbox"/> <b>REVISE &amp; RESUBMIT</b>	<input type="checkbox"/> <b>SUBMIT SPECIFIC ITEM</b>  <input type="checkbox"/> <b>REJECTED</b>			
<b>Reviewed by:</b>  		<b>Date:</b>  		
<b>Remarks:</b>				

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## ELECTRONIC DOCUMENT REQUEST FORM

From (Company):

Address:

Contact:

Phone:

Project Name:

Location:

DSA App. No.:

LPA Project No.:

Execution of this document will confirm your request for copies of documentation related to the above referenced project. Please return one fully executed copy of this form via mail to LPA, Inc., **431 I Street, Suite 107, Sacramento, CA 95814**; or via Email.

### Description of Documentation Requested:

Type of Files Needed: ☐ DWG (AutoCAD) ☐ Other \_\_\_\_\_ (subject to review and approval)

### Purpose of Request and Specific Sheets Requested:

**If Requestor is a subcontractor to the project's General Contractor**, A written statement by the Project's General Contractor authorizing LPA to release documentation to a subcontractor of the General Contractor must be written below:

**If Requestor is a consultant to the Project's Owner**, please indicate below the name and phone number of the contact at Owner's Office:

**Disclaimer:** LPA can only release electronic files to the Project's Owner, consultants to the Project's Owner and/or the Projects' General Contractor. Please be advised that, in the case of existing construction, the documents requested are reproductions of documentation on file and do not necessarily represent as-built or existing conditions. LPA does not warrant, in any way, the accuracy of this information and shall not be responsible for any discrepancy between this documentation and the existing conditions.

In the case of projects which are currently being designed and/or under construction, the electronic documentation are reproductions of the documentation on file and may be subject to change due to Owner, field and/or coordination revisions. LPA shall not be responsible for reissuing files beyond the Bid Document files which may be revised after issuance of these requested files and shall not be responsible for advising other parties as to the status of document revisions. Also, please be advised that the requested documents are instruments of service and, as such, remain the property of LPA and/or the respective consultant. Any unauthorized re-use of these documents without the written authorization of LPA and/or consultant is strictly prohibited.

Please note all disclaimers and warnings printed on electronic media labels. Electronic media may contain undetected viruses. It is always recommended that disks be checked prior to use. LPA assumes no liability or responsibility for damage to user's property as a result of using this electronic media or its contents.

**Fees:** The charge for copying the requested files in DWG (AutoCAD) is **\$100.00** per sheet. The cost per sheet / files on a different software platform will be determined based on what is requested. Details are not released.

Other costs to be charged for the requested files may include archive storage and retrieval charges, reproduction and handling expenses, etc. The exact costs for these miscellaneous expenses will be determined by LPA upon execution of this request.

**Payment of these costs must be made by the Requestor prior to shipping of the requested documents.**

By signing this Request, the Requestor agrees to the disclaimer and reimbursement fees to LPA, Inc. as stated above:

Authorized Name and Signature:

Date:

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## SECTION 01 3216 CONSTRUCTION PROGRESS SCHEDULE

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Preliminary schedule.
- B. Construction progress schedule, bar chart type.

#### 1.02 REFERENCE STANDARDS

#### 1.03 SUBMITTALS

- A. Within 10 days after date of Agreement, submit preliminary schedule.
- B. Within 10 days after joint review, submit complete schedule.
- C. Submit updated schedule with each Application for Payment.
- D. Submit the number of opaque reproductions that Contractor requires, plus two copies that will be retained by Architect.
- E. Submit one reproducible transparency and one opaque reproduction.

#### 1.04 QUALITY ASSURANCE

- A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with 5 years minimum experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

#### 1.05 SCHEDULE FORMAT

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.
- B. Sheet Size: Multiples of 8-1/2 x 11 inches.

### PART 2 PRODUCTS - NOT USED

### PART 3 EXECUTION

#### 3.01 PRELIMINARY SCHEDULE

- A. Prepare preliminary schedule in the form of a horizontal bar chart.

#### 3.02 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- D. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, products identified under Allowances, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.
- E. Provide legend for symbols and abbreviations used.

#### 3.03 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

#### 3.04 REVIEW AND EVALUATION OF SCHEDULE

- A. Participate in joint review and evaluation of schedule with Architect at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.

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- C. After review, revise as necessary as result of review, and resubmit within 10 days.

### **3.05 UPDATING SCHEDULE**

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.

### **3.06 DISTRIBUTION OF SCHEDULE**

- A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

**END OF SECTION 01 3216**

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**SECTION 01 3513  
SPECIAL PROJECT PROCEDURES - DESIGN PRESENTATION**

**PART 1 - GENERAL**

**1.01 DESIGN PRESENTATION TO THE CONSTRUCTION TEAM BY THE ARCHITECT**

- A. A descriptive and informative presentation of the project design will be scheduled at the jobsite immediately following the preconstruction conference. The following project team members are required to attend. Attendance is mandatory.
  - 1. Owner's representative.
  - 2. Architect's representative.
  - 3. Architect's consultants, including:
    - a. Landscape architect.
    - b. Civil engineer.
    - c. Structural engineer.
    - d. Mechanical engineer.
    - e. Plumbing engineer.
    - f. Electrical engineer.
    - g. Other consultants.
  - 4. Construction Manager, Prime and Subprime contractors including:
    - a. Project managers.
    - b. Superintendents.
    - c. Foremen.
    - d. Field office staff.
  - 5. General Contractor and major subcontractors, including:
    - a. Project managers.
    - b. Superintendents.
    - c. Foremen.
    - d. Field office staff.
  - 6. Building Inspectors (where feasible).
  - 7. Inspector of Record (for DSA projects).
- B. The purpose of the design presentation to the construction field personnel is to create a sense of partnership in and responsibility for the realization of the design intent, and to encourage active participation by all parties involved to realize the Owner's project goals.
  - 1. The presentation is intended to bring together the design team, Owner, and key construction personnel and foster a closer working collaboration.
  - 2. The presentation is intended to foster a partnering between all parties to encourage creative solutions and ideas to solve problems that arise during construction, based upon a clearer knowledge of the project design intent.
- C. The design presentation shall include the rationale governing the building and site aesthetic design.
  - 1. The presentation will identify key architectural features, details, and materials as well as systems critical to the realization of the design intent and project goals.
  - 2. Sustainable design requirements will be presented, including the following:
    - a. Leadership in Energy and Environmental Design (LEED).
    - b. Collaborative for High Performance Schools (CHPS).
  - 3. Special mechanical, electrical and plumbing systems and components shall be presented by the Architect's MEP consultants.
  - 4. Special or unique civil design requirements and components shall be presented by the Architect's civil consultants.
  - 5. Additional presentations for unique systems and components shall be made by the responsible design entity.

**END OF SECTION 01 3513**

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## SECTION 01 4000 QUALITY REQUIREMENTS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Submittals.
- B. Quality assurance.
- C. References and standards.
- D. Control of installation.
- E. Mock-ups.
- F. Tolerances.
- G. Manufacturers' field services.
- H. Defect Assessment.

#### 1.02 RELATED REQUIREMENTS

- A. Section 01 4010 - DSA Quality Requirements and Test & Inspections

#### 1.03 REFERENCE STANDARDS

- A. Title 24 CCR, Part 1: Continuous inspection, Section 4-333
- B. CBC Chapter 17A - California Building Code Structural Testing and Inspection

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

#### 1.05 REFERENCES AND STANDARDS

- A. For products and 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 reference standard of date of issue current on date specified in the individual specification sections, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

### PART 2 PRODUCTS - NOT USED

### PART 3 EXECUTION

#### CONTROL OF INSTALLATION

- 4.01 MONITOR QUALITY CONTROL OVER SUPPLIERS, MANUFACTURERS, PRODUCTS, SERVICES, SITE CONDITIONS, AND WORKMANSHIP, TO PRODUCE WORK OF SPECIFIED QUALITY.
- 4.02 COMPLY WITH MANUFACTURERS' INSTRUCTIONS, INCLUDING EACH STEP IN SEQUENCE.
- 4.03 COMPLY WITH SPECIFIED STANDARDS AS MINIMUM QUALITY FOR THE WORK EXCEPT WHERE MORE STRINGENT TOLERANCES, CODES, OR SPECIFIED REQUIREMENTS INDICATE HIGHER STANDARDS OR MORE PRECISE WORKMANSHIP.
- 4.04 HAVE WORK PERFORMED BY PERSONS QUALIFIED TO PRODUCE REQUIRED AND SPECIFIED QUALITY.

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**4.05 VERIFY THAT FIELD MEASUREMENTS ARE AS INDICATED ON SHOP DRAWINGS OR AS INSTRUCTED BY THE MANUFACTURER.**

**4.06 SECURE PRODUCTS IN PLACE WITH POSITIVE ANCHORAGE DEVICES DESIGNED AND SIZED TO WITHSTAND STRESSES, VIBRATION, PHYSICAL DISTORTION, AND DISFIGUREMENT.**

**4.07 MOCK-UPS**

- A. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

**4.08 TOLERANCES**

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Adjust products to appropriate dimensions; position before securing products in place.

**4.09 DEFECT ASSESSMENT**

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

**END OF SECTION 01 4000**

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## SECTION 01 4010 DSA QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes administrative and procedural requirements for DSA-approved quality assurance and quality control.
- B. DSA-approved testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. A Class I Project Inspector employed by the School District and approved by DSA shall provide continuous inspection of the work per Title 24 CCR, Part 1, Section 4-333. The duties of the Project Inspector are defined in Title 24 CCR, Part 1, Section 4-342.
  - 2. Testing and inspection shall comply with Title 24 CCR, Part 1, Section 4-335.
    - a. Required special tests and inspections shall comply with CBC Chapter 17A.  
Required special tests and inspections shall be as indicated on the DSA-approved Form 103, 'Statement of Structural Tests and Special Inspections'.
    - b. A copy of the DSA 103 form is included at the end of this section.
  - 3. All testing and inspection laboratories shall be approved by DSA and employeeed by the Owner.
  - 4. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
  - 5. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
  - 6. Requirements for Contractor to provide quality-assurance and control services required by Architect, Owner, Construction Manager or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections:
  - 1. Divisions 02 through 33 Sections for specific test and inspection requirements.

#### 1.02 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect or Construction Manager.
- C. Preconstruction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

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- G. Testing Agency: A DSA-approved entity engaged to perform specific tests, inspections, or both. DSA-approved testing agencies shall have a current DSA Laboratory Evaluation and Acceptance (LEA) program number. Testing laboratory shall mean the same as testing agency.
- H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
  - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.
- I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- J. Project Inspector: A Project Inspector employed by the School District and approved by DSA shall provide continuous inspection of the work per Title 24 CCR, Part 1, Section 4-333. The duties of the Project Inspector are defined in Title 24 CCR, Part 1, Section 4-342. "Special Inspector" and "Inspector of Record" shall mean the same as Project Inspector.

### 1.03 CONFLICTING REQUIREMENTS

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

### 1.04 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: In accordance with CBC Section 1706A, submit copy of written statement of responsibility sent to DSA before starting work on the following systems.
  - 1. Seismic-force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by the Architect or the Structural Engineer of Record.
  - 2. Main wind-force resisting system or a wind-resisting component listed in the wind-force-resisting system quality assurance plan prepared by the Architect or the Structural Engineer of Record.

### 1.05 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports where specified in other Sections. Test and inspection reports shall comply with DSA reporting requirements for testing laboratories, as indicated in DSA reporting forms and templates numbers DSA-201 through DSA-293, inclusive. Where there is no DSA reporting template, test and inspection reports shall include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, and telephone number of testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making tests and inspections.
  - 6. Description of the Work and test and inspection method.
  - 7. Identification of product and Specification Section.

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

#### **1.06 QUALITY ASSURANCE**

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

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- F. Testing Agency Qualifications: An agency with current DSA LEA program approval.
- G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
  - 1. Contractor responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Provide sizes and configurations of test assemblies, mockups and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
    - d. Build mockups and site-assembled test assemblies using installers who will perform same tasks for Project.
    - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
    - f. When testing is complete, remove mockups, test specimens and assemblies; do not reuse products on Project.
  - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, through Construction Manager, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

#### **1.07 QUALITY CONTROL**

- A. Owner Responsibilities: Owner will engage one or more DSA-approved, qualified testing agencies to perform these services.
  - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
  - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
  - 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
  - 2. Notify testing agencies at least 48 hours in advance of time when Work that requires testing or inspecting will be performed.
  - 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  - 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  - 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

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- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
  - 1. Notify Architect, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  - 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
  - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  - 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
  - 1. Access to the Work.
  - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
  - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  - 4. Facilities for storage and field curing of test samples.
  - 5. Delivery of samples to testing agencies.
  - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
  - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
  - 1. Distribution: Distribute schedule to Owner, Architect, Construction Manager, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

## 1.08 SPECIAL TESTS AND INSPECTIONS

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- A. Special Tests and Inspections: Owner will engage a DSA-approved, qualified testing agency and special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in DSA Form 103, "Statement of Structural Tests and Special Inspections".

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.01 TEST AND INSPECTION LOG**

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

### **3.02 REPAIR AND PROTECTION**

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

**END OF SECTION 014010 01 4010**

## DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS, 2019 CBC

<b>Application Number:</b> 02-119490	<b>School Name:</b> Davis Senior High School	<b>School District:</b> Davis Joint Unified School District
<b>DSA File Number:</b> 57-H3	<b>Increment Number:</b>	<b>Date Created:</b> 2021-10-25 21:45:46

### 2019 CBC

**IMPORTANT:** This form is only a summary list of structural tests and some of the special inspections required for the project. Generally, the structural tests and special inspections noted on this form are those that will be performed by the Geotechnical Engineer of Record, Laboratory of Record, or Special Inspector. The actual complete test and inspection program must be performed as detailed on the DSA approved documents. The appendix at the bottom of this form identifies work NOT subject to DSA requirements for special inspection or structural testing. The project inspector is responsible for providing inspection of all facets of construction, including but not limited to, special inspections not listed on this form such as structural wood framing, high-load wood diaphragms, cold-formed steel framing, anchorage of non-structural components, etc., per Title 24, Part 2, Chapter 17A (2019 CBC).

**\*\*NOTE:** Undefined section and table references found in this document are from the CBC, or California Building Code.

#### KEY TO COLUMNS

1. TYPE	2. PERFORMED BY
<b>Continuous</b> – Indicates that a continuous special inspection is required	<b>GE</b> – Indicates that the special inspection shall be performed by a registered geotechnical engineer or his or her authorized representative.
<b>Periodic</b> – Indicates that a periodic special inspection is required	<b>LOR</b> – Indicates that the test or special inspection shall be performed by a testing laboratory accepted in the DSA Laboratory Evaluation and Acceptance (LEA) Program. See CAC Section 4-335.
<b>Test</b> – Indicates that a test is required	<b>PI</b> – Indicates that the special inspection may be performed by a project inspector when specifically approved by DSA.
	<b>SI</b> – Indicates that the special inspection shall be performed by an appropriately qualified/approved special inspector.

## DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS (SOILS), 2019 CBC

<b>Application Number:</b> 02-119490	<b>School Name:</b> Davis Senior High School	<b>School District:</b> Davis Joint Unified School District
<b>DSA File Number:</b> 57-H3	<b>Increment Number:</b>	<b>Date Created:</b> 2021-10-25 21:45:46

### Geotechnical Reports: Project has a geotechnical report, or CDs indicate soils special inspection is required by GE

	1. GENERAL:	Table 1705A.6		
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input checked="" type="checkbox"/>	<b>a.</b> Verify that: <ul style="list-style-type: none"><li>• Site has been prepared properly prior to placement of controlled fill and/or excavations for foundations.</li><li>• Foundation excavations are extended to proper depth and have reached proper material.</li><li>• Materials below footings are adequate to achieve the design bearing capacity.</li></ul>	Periodic	GE*	* By geotechnical engineer or his or her qualified representative. (See Appendix for exemptions.)

	2. SOIL COMPACTION AND FILL:	Table 1705A.6		
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input type="checkbox"/>	<b>a.</b> Perform classification and testing of fill materials.	Test	LOR*	* Under the supervision of the geotechnical engineer.
<input checked="" type="checkbox"/>	<b>b.</b> Verify use of proper materials, densities and inspect lift thicknesses, placement and compaction during placement of fill.	Continuous	GE*	* By geotechnical engineer or his or her qualified representative. (Refer to specific items identified in the Appendix for exemptions where soils SI and testing may be conducted under the supervision of a geotechnical engineer or LOR's engineering manager. In such cases, the LOR's form DSA 291 shall satisfy the soil SI and test reporting requirements for the exempt items.)

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<input checked="" type="checkbox"/>	c. Compaction testing.	<b>Test</b>	<b>LOR*</b>	* Under the supervision of the geotechnical engineer. (Refer to specific items identified in the Appendix for exemptions where soils testing may be conducted under the supervision of a geotechnical engineer or LOR's engineering manager. In such cases, the LOR's form DSA 291 shall satisfy the soil test reporting requirements for the exempt items.)
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	<b>3. DRIVEN DEEP FOUNDATIONS (PILES):</b>	<b>Table 1705A.7</b>		
	<b>Test or Special Inspection</b>	<b>Type</b>	<b>Performed By</b>	<b>Code References and Notes</b>
<input type="checkbox"/>	a. Verify pile materials, sizes and lengths comply with the requirements.	<b>Continuous</b>	<b>GE*</b>	* By geotechnical engineer or his or her qualified representative.
<input type="checkbox"/>	b. Determine capacities of test piles and conduct additional load tests as required.	<b>Test</b>	<b>LOR*</b>	* Under the supervision of the geotechnical engineer.
<input type="checkbox"/>	c. Inspect driving operations and maintain complete and accurate records for each pile.	<b>Continuous</b>	<b>GE*</b>	* By geotechnical engineer or his or her qualified representative.
<input type="checkbox"/>	d. Verify locations of piles and their plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and record any pile damage.	<b>Continuous</b>	<b>GE*</b>	* By geotechnical engineer or his or her qualified representative.
<input type="checkbox"/>	e. Steel piles.	Provide tests and inspections per STEEL section below.		
<input type="checkbox"/>	f. Concrete piles and concrete filled piles.	Provide tests and inspections per CONCRETE section below.		

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<input type="checkbox"/>	<b>g.</b> For specialty piles, perform additional inspections as determined by the registered design professional in responsible charge.	*	*	* As defined on drawings or specifications.
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	<b>4. CAST-IN-PLACE DEEP FOUNDATIONS (PIERS):</b>	Table 1705A.8		
	<b>Test or Special Inspection</b>	<b>Type</b>	<b>Performed By</b>	<b>Code References and Notes</b>
<input checked="" type="checkbox"/>	<b>a.</b> Inspect drilling operations and maintain complete and accurate records for each pier.	Continuous	GE*	* By geotechnical engineer or his or her qualified representative. (See Appendix for exemptions.)
<input checked="" type="checkbox"/>	<b>b.</b> Verify pier locations, diameters, plumbness, bell diameters (if applicable), lengths and embedment into bedrock (if applicable); record concrete or grout volumes.	Continuous	GE*	* By geotechnical engineer or his or her qualified representative. (See Appendix for exemptions.)
<input type="checkbox"/>	<b>c.</b> Confirm adequate end strata bearing capacity.	Continuous	GE*	* By geotechnical engineer or his or her qualified representative. (See Appendix for exemptions.)
<input checked="" type="checkbox"/>	<b>d.</b> Concrete piers.	Provide tests and inspections per CONCRETE section below.		

	<b>5. RETAINING WALLS:</b>			
	<b>Test or Special Inspection</b>	<b>Type</b>	<b>Performed By</b>	<b>Code References and Notes</b>
<input type="checkbox"/>	<b>a.</b> Placement, compaction and inspection of backfill.	Continuous	GE*	<b>1705A.6.1.</b> * By geotechnical engineer or his or her qualified representative. (See Section 2 above).

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<input type="checkbox"/>	<b>b.</b> Placement of soil reinforcement and/or drainage devices.	<b>Continuous</b>	<b>GE*</b>	* By geotechnical engineer or his or her qualified representative.
<input type="checkbox"/>	<b>c.</b> Segmental retaining walls; inspect placement of units, dowels, connectors, etc.	<b>Continuous</b>	<b>GE*</b>	* By geotechnical engineer or his or her qualified representative. See DSA IR 16-3.
<input type="checkbox"/>	<b>d.</b> Concrete retaining walls.	Provide tests and inspections per CONCRETE section below.		
<input type="checkbox"/>	<b>e.</b> Masonry retaining walls.	Provide tests and inspections per MASONRY section below.		

	<b>6. OTHER SOILS:</b>			
	<b>Test or Special Inspection</b>	<b>Type</b>	<b>Performed By</b>	<b>Code References and Notes</b>
<input type="checkbox"/>	<b>a.</b> Soil Improvements	<b>Test</b>	<b>GE*</b>	Submit a comprehensive report documenting final soil improvements constructed, construction observation and the results of the confirmation testing and analysis to CGS for final acceptance. * By geotechnical engineer or his or her qualified representative.
<input type="checkbox"/>	<b>b.</b> Inspection of Soil Improvements	<b>Continuous</b>	<b>GE*</b>	* By geotechnical engineer or his or her qualified representative.
<input type="checkbox"/>	<b>c.</b>			

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Table 1705A.3; ACI 318-14 Sections 26.12 & 26.13

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7. CAST-IN-PLACE CONCRETE				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<b>Material Verification and Testing:</b>				
<input checked="" type="checkbox"/>	a. Verify use of required design mix.	Periodic	SI	Table 1705A.3 Item 5, 1910A.1.
<input checked="" type="checkbox"/>	b. Identify, sample, and test reinforcing steel.	Test	LOR	1910A.2; ACI 318-14 Section 26.6.1.2; DSA IR 17-10. (See Appendix for exemptions.)
<input checked="" type="checkbox"/>	c. During concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	Test	LOR	Table 1705A.3 Item 6; ACI 318-14 Sections 26.5 & 26.12.
<input checked="" type="checkbox"/>	d. Test concrete ( $f'_c$ ).	Test	LOR	1905A.1.15; ACI 318-14 Section 26.12.
<b>Inspection:</b>				
<input checked="" type="checkbox"/>	e. Batch plant inspection: <b>Continuous</b>	See Notes	SI	Default of 'Continuous' per 1705A.3.3. If approved by DSA, batch plant inspection may be reduced to 'Periodic' subject to requirements in Section 1705A.3.3.1, or eliminated per 1705A.3.3.2. (See Appendix for exemptions.)
<input checked="" type="checkbox"/>	f. Welding of reinforcing steel.	Provide special inspection per STEEL, Category 19.1(d) & (e) and/or 19.2(g) & (h) below.		

<b>8. PRESTRESSED / POST-TENSIONED CONCRETE (in addition to Cast-in-Place Concrete tests and inspections):</b>
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# DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS (Concrete), 2019 CBC

Table 1705A.3; ACI 318-14 Sections 26.12 & 26.13

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	Test or Special Inspection	Type	Performed By	Code References and Notes
<input type="checkbox"/>	a. Sample and test prestressing tendons and anchorages.	Test	LOR	1705A.3.4, 1910A.3
<input type="checkbox"/>	b. Inspect placement of prestressing tendons.	Periodic	SI	1705A.3.4, Table 1705A.3 Items 1 & 9.
<input type="checkbox"/>	c. Verify in-situ concrete strength prior to stressing of post-tensioning tendons.	Periodic	SI	Table 1705A.3 Item 11. Special inspector to verify specified concrete strength test prior to stressing.
<input type="checkbox"/>	d. Inspect application of post-tensioning or prestressing forces and grouting of bonded prestressing tendons.	Continuous	SI	1705A.3.4, Table 1705A.3 Item 9; ACI 318-14 Section 26.13

	9. PRECAST CONCRETE (in addition to Cast-in-Place Concrete tests and inspections):			
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input type="checkbox"/>	a. Inspect fabrication of precast concrete members.	Continuous	SI	ACI 318-14 Section 26.13.
<input type="checkbox"/>	b. Inspect erection of precast concrete members.	Periodic	SI*	Table 1705A.3 Item 10. * May be performed by PI when specifically approved by DSA.

	10. SHOTCRETE (in addition to Cast-in-Place Concrete tests and inspections):			
	Test or Special Inspection	Type	Performed By	Code References and Notes

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Table 1705A.3; ACI 318-14 Sections 26.12 & 26.13

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<input type="checkbox"/>	<b>a.</b> Inspect shotcrete placement for proper application techniques.	<b>Continuous</b>	<b>SI</b>	<b>1705A.19, Table 1705A.3 Item 7, 1908A.6, 1908A.7, 1908A.8, 1908A.9, 1908A.11, 1908A.12.</b> See ACI 506.2-13 Section 3.4, ACI 506R-16.
<input type="checkbox"/>	<b>b.</b> Sample and test shotcrete ( $f'_c$ ).	<b>Test</b>	<b>LOR</b>	<b>1908A.5, 1908A.10.</b>

	<b>11. POST-INSTALLED ANCHORS:</b>			
	<b>Test or Special Inspection</b>	<b>Type</b>	<b>Performed By</b>	<b>Code References and Notes</b>
<input checked="" type="checkbox"/>	<b>a.</b> Inspect installation of post-installed anchors	<b>See Notes</b>	<b>SI*</b>	<b>1617A.1.19, Table 1705A.3 Item 4a (Continuous) &amp; 4b (Periodic), 1705A.3.8</b> (See Appendix for exemptions). ACI 318-14 Sections 17.8 & 26.13. * May be performed by the project inspector when specifically approved by DSA.
<input checked="" type="checkbox"/>	<b>b.</b> Test post-installed anchors.	<b>Test</b>	<b>LOR</b>	<b>1910A.5.</b> (See Appendix for exemptions.)

	<b>12. OTHER CONCRETE:</b>			
	<b>Test or Special Inspection</b>	<b>Type</b>	<b>Performed By</b>	<b>Code References and Notes</b>
<input type="checkbox"/>	<b>a.</b>			

# DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS (Masonry), 2019 CBC

1705A.4; TMS 602-16, Tables 3 and 4.

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	13. STRUCTURAL MASONRY: 2000 psi			
	Test or Special Inspection	Type	Performed By	Code References and Notes
Material Verification and Testing: (See Appendix for exemptions.)				
☑	a. Mill certificate indicates compliance with requirements for reinforcement, anchors, ties, fasteners and metal accessories. See item 7b for identification, sampling and testing of reinforcing steel.	Periodic	SI*	2103A.4; TMS 602-13 Article 1.5B.2 & 2.4. * To be performed by qualified LOR representative. Applicable testing by LOR. See IR 17-10.16 for unidentified reinforcing steel.
☑	b. Producer's certificate of compliance for masonry units, mortar and grout materials.	Test	LOR	1705A.4, 2103A.2.1, 2103A.3, 2103A.5; TMS 602-16 Articles 2.1, 2.2, 2.6A and 2.6B, and Table 6 footnote 3.
☑	c. Test masonry ( $f'_m$ ).	Test	LOR	1705A.4. For Unit Strength: 2105A.3 (2114.6.1+); TMS 602-16 Articles 1.4B.2, 1.5B.1 & 1.5B.2. For Prism (required when $f'_m > 2000$ psi): 2105A.2; TMS 602-16 Articles 1.4B.3, 1.4B.4, 1.5B.1 & 1.5B.2.
☑	d. Verify proportions of site prepared, premixed or preblended mortar and grout.	Periodic	SI	TMS 602-16 Table 3 Item 5, Table 4 Item 1a & 2d.
☑	e. Test core-drilled samples.	Test	LOR	2105A.4. (See Appendix for exemptions.)
Inspection: (See Appendix for exemptions.)				
☑	f. Inspect preparation of prisms.	Continuous	SI	TMS 602-16 Articles 1.4.B.3 & 1.4.B.4 & Table 4 Item 4.
☑	g. Verify size, location and condition of all dowels, construction supporting masonry, etc.	Periodic	SI	

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1705A.4; TMS 602-16, Tables 3 and 4.

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<input checked="" type="checkbox"/>	<b>h.</b> Verify size, grade and type of reinforcement and anchor bolts.	<b>Periodic</b>	<b>SI</b>	TMS 602-16 Table 4 Item 1c.
<input checked="" type="checkbox"/>	<b>i.</b> Welding of reinforcing steel.	TMS 602-16 Table 4 Item 3e. Provide special inspection per STEEL, Category 19.1(d) & (e) and/or 19.2(g) & (h) below.		
<input checked="" type="checkbox"/>	<b>j.</b> Inspect placement of reinforcement and connectors.	<b>Continuous</b>	<b>SI</b>	TMS 602-16 Table 4 Item 2c.
<input checked="" type="checkbox"/>	<b>k.</b> Inspect placement of masonry units and construction of mortar joints.	<b>Periodic</b>	<b>SI</b>	TMS 602-16 Table 4 Item 3b.
<input checked="" type="checkbox"/>	<b>l.</b> Verify preparation, construction and protection of masonry during cold weather (temperature below 40° F) or hot weather (temperature above 90° F).	<b>Periodic</b>	<b>SI*</b>	TMS 602-16 Table 4 Item 3f. * May be performed by the project inspector when specifically approved by DSA.
<input checked="" type="checkbox"/>	<b>m.</b> Inspect type, size and location of anchors and all other items to embedded in masonry including other details of anchorage of masonry to structural members, frames and other construction.	<b>Continuous</b>	<b>SI</b>	TMS 602-16 Table 4 Item 3d.
<input checked="" type="checkbox"/>	<b>n.</b> Inspect grout space prior to placement of grout.	<b>Continuous</b>	<b>SI</b>	TMS 602-16 Table 4 Item 2a.

<b>14. VENEER OR GLASS BLOCK PARTITIONS: 1705A.4.1; TMS 602-16 Tables 3 and 4.</b>				
	<b>Test or Special Inspection</b>	<b>Type</b>	<b>Performed By</b>	<b>Code References and Notes</b>
<input type="checkbox"/>	<b>a.</b> Verify proportions of siteprepared mortar and grout and/or verify certification of premixed mortar.	<b>Periodic</b>	<b>SI</b>	TMS 602-16 Table 3 Item 5 and Table 4 Items 1a & 2d.

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1705A.4; TMS 602-16, Tables 3 and 4.

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<input type="checkbox"/>	<b>b.</b> Inspect placement of units and construction of mortar joints.	<b>Periodic</b>	<b>SI</b>	TMS 602-16 Table 4 Item 3b.
<input type="checkbox"/>	<b>c.</b> Inspect placement of reinforcement, connectors and anchors.	<b>Periodic</b>	<b>SI</b>	TMS 602-16 Table 4 Item 2c.
<input type="checkbox"/>	<b>d.</b> Inspect type, size and location of anchors and all other items to be embedded in masonry including details of anchorage of masonry to structural members, frames and other construction.	<b>Periodic</b>	<b>SI</b>	TMS 602-16 Table 4 Item 3d.
<input type="checkbox"/>	<b>e.</b> Verify preparation, construction and protection of masonry during cold weather (temperature below 40° F) or hot weather (above 90° F).	<b>Periodic</b>	<b>SI*</b>	TMS 602-16 Table 4 Item 3f. * May be performed by the project inspector when specifically approved by DSA.
<input type="checkbox"/>	<b>f.</b> Test veneer bond strength	<b>Test</b>	<b>LOR</b>	<b>1410.2.1; TMS 402 Article 12.3.2.4. (Field constructed mock-up laboratory tested in accordance with ASTM C482).</b>

	<b>15. POST-INSTALLED ANCHORS IN MASONRY:</b>			
	<b>Test or Special Inspection</b>	<b>Type</b>	<b>Performed By</b>	<b>Code References and Notes</b>
<input checked="" type="checkbox"/>	<b>a.</b> Inspect installation of postinstalled anchors	<b>See Notes</b>	<b>SI*</b>	<b>1617A.1.19, 1705A.4, Table 1705A.3 Item 4a (Continuous) &amp; 4b (Periodic);</b> ACI 318-14 Sections 17.8 & 26.13. * May be performed by the project inspector when specifically approved by DSA. (See Appendix for exemptions.)
<input checked="" type="checkbox"/>	<b>b.</b> Test post-installed anchors.	<b>Test</b>	<b>LOR</b>	<b>1705A.4, 1910A.5.</b> (See Appendix for exemptions.)

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1705A.4; TMS 602-16, Tables 3 and 4.

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	<b>16. OTHER MASONRY:</b>			
	<b>Test or Special Inspection</b>	<b>Type</b>	<b>Performed By</b>	<b>Code References and Notes</b>
<input type="checkbox"/>	a.			

## DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS (Steel and Aluminum), 2019 CBC

1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16

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17. STRUCTURAL STEEL, COLD-FORMED STEEL AND ALUMINUM USED FOR STRUCTURAL PURPOSES				
Material Verification and Testing:				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input checked="" type="checkbox"/>	a. Verify identification of all materials and: • Mill certificates indicate material properties that comply with requirements. • Material sizes, types and grades comply with requirements.	Periodic	*	Table 1705A.2.1 Item 3a 3c. 2202A.1; AISI S100-16 Section A3.1 & A3.2, AISI S240-15 Section A3 & A5, AISI S220-15 Sections A4 & A6. * By special inspector or qualified technician when performed off-site.
<input checked="" type="checkbox"/>	b. Test unidentified materials	Test	LOR	2202A.1.
<input checked="" type="checkbox"/>	c. Examine seam welds of HSS shapes	Periodic	SI	DSA IR 17-3.
Inspection:				
<input checked="" type="checkbox"/>	d. Verify and document steel fabrication per DSA-approved construction documents.	Periodic	SI	Not applicable to cold-formed steel light-frame construction, except for trusses (1705A.2.4).

18. HIGH-STRENGTH BOLTS: RCSC 2014				
Material Verification and Testing of High-Strength Bolts, Nuts and Washers:				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input checked="" type="checkbox"/>	a. Verify identification markings and manufacturer's certificates of compliance conform to ASTM standards specified in the DSA-approved documents.	Periodic	SI	Table 1705A.2.1 Items 1a & 1b, 2202A.1; AISC 360-16 Section A3.3, J3.1, and N3.2; RCSC 2014 Section 1.5 & 2.1; DSA IR 17-8 & DSA IR 17-9.

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1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16

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<input checked="" type="checkbox"/>	<b>b.</b> Test high-strength bolts, nuts and washers.	<b>Test</b>	<b>LOR</b>	<b>Table 1705A.2.1 Item 1c, 2213A.1;</b> RCSC 2014 Section 7.2; DSA IR 17-8.
<b>Inspection of High-Strength Bolt Installation:</b>				
<input checked="" type="checkbox"/>	<b>c.</b> Bearing-type ("snug tight") connections.	<b>Periodic</b>	<b>SI</b>	<b>Table 1705A.2.1 Item 2a, 1705A.2.6, 2204A.2;</b> AISC 360-16 J3.1, J3.2, M2.5 & N5.6; RCSC 2014 Section 9.1; DSA IR 17-9.
<input checked="" type="checkbox"/>	<b>d.</b> Pretensioned and slip-critical connections.	*	<b>SI</b>	<b>Table 1705A.2.1 Items 2b &amp; 2c, 1705A.2.6, 2204A.2;</b> AISC 360-16 J3.1, J3.2, M2.5 & N5.6; RCSC 2014 Sections 9.2 & 9.3; DSA IR 17-9. * "Continuous" or "Periodic" depends on the tightening method used.

	<b>19. WELDING:</b>	<b>1705A.2.5, Table 1705A.2.1 Items 4 &amp; 5;</b> AWS D1.1 and AWS D1.8 for structural steel; AWS D1.2 for Aluminum; AWS D1.3 for cold-formed steel; AWS D1.4 for reinforcing steel; DSA IR 17-3 (See Appendix for exemptions.)		
Verification of Materials, Equipment, Welders, etc.:				
	Test or Special Inspection	Type	Performed By	Code References and Notes
☑	a. Verify weld filler material identification markings per AWS designation listed on the DSA-approved documents and the WPS.	Periodic	SI	DSA IR 17-3.
☑	b. Verify weld filler material manufacturer’s certificate of compliance.	Periodic	SI	DSA IR 17-3.
☑	c. Verify WPS, welder qualifications and equipment.	Periodic	SI	DSA IR 17-3.

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1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16

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19.1 SHOP WELDING:				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input checked="" type="checkbox"/>	a. Inspect groove welds, multi-pass fillet welds, single pass fillet welds > 5/16", plug and slot welds.	Continuous	SI	Table 1705A.2.1 Items 5a.1 4; AISC 360-16 (and AISC 341-16 as applicable); DSA IR 17-3.
<input checked="" type="checkbox"/>	b. Inspect single-pass fillet welds ≤ 5/16", floor and roof deck welds.	Periodic	SI	1705A.2.2, Table 1705A.2.1 Items 5a.5 & 5a.6; AISC 360-16 (and AISC 341-16 as applicable); DSA IR 17-3.
<input type="checkbox"/>	c. Inspect welding of stairs and railing systems.	Periodic	SI	1705A.2.1; AISC 360-16 (and AISC 341-16 as applicable); AWS D1.1 & D1.3; DSA IR 17-3.
<input checked="" type="checkbox"/>	d. Verification of reinforcing steel weldability other than ASTM A706.	Periodic	SI	1705A.3.1; AWS D1.4; DSA IR 17-3. Verify carbon equivalent reported on mill certificates.
<input checked="" type="checkbox"/>	e. Inspect welding of reinforcing steel.	Continuous	SI	Table 1705A.2.1 Item 5b, 1705A.3.1, Table 1705A.3 Item 2, 1903A.8; AWS D1.4; DSA IR 17-3.

19.2 FIELD WELDING:				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input checked="" type="checkbox"/>	a. Inspect groove welds, multi-pass fillet welds, single pass fillet welds > 5/16", plug and slot welds.	Continuous	SI	Table 1705A.2.1 Items 5a.1 4; AISC 360-16 (AISC 341-16 as applicable); DSA IR 17-3.
<input checked="" type="checkbox"/>	b. Inspect single-pass fillet welds ≤ 5/16".	Periodic	SI	Table 1705A.2.1 Item 5a.5; AISC 360-16 (AISC 341-16 as applicable); DSA IR 17-3.

# DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS (Steel and Aluminum), 2019 CBC

1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16

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<input type="checkbox"/>	<b>c.</b> Inspect end-welded studs (ASTM A-108) installation (including bend test).	<b>Periodic</b>	<b>SI</b>	<b>2213A.2;</b> AISC 360-16 (AISC 341-16 as applicable); AWS D1.1; DSA IR 17-3.
<input checked="" type="checkbox"/>	<b>d.</b> Inspect floor and roof deck welds.	<b>Periodic</b>	<b>SI</b>	<b>1705A.2.2, Table 1705A.2.1 Item 5a.6;</b> AISC 360-16 (AISC 341-16 as applicable); AWS D1.3; DSA IR 17-3.
<input checked="" type="checkbox"/>	<b>e.</b> Inspect welding of structural cold-formed steel.	<b>Periodic</b>	<b>SI*</b>	<b>1705A.2.5; AWS D1.3; DSA IR 17-3.</b> The quality control provisions of AISI S240-15 Chapter D shall also apply. * May be performed by the project inspector when specifically approved by DSA.
<input type="checkbox"/>	<b>f.</b> Inspect welding of stairs and railing systems.	<b>Periodic</b>	<b>SI*</b>	<b>1705A.2.1;</b> AISC 360-16 (AISC 341-16 as applicable); AWS D1.1 & D1.3; DSA IR 17-3. * May be performed by the project inspector when specifically approved by DSA.
<input checked="" type="checkbox"/>	<b>g.</b> Verification of reinforcing steel weldability.	<b>Periodic</b>	<b>SI</b>	<b>1705A.3.1;</b> AWS D1.4; DSA IR 17-3. Verify carbon equivalent reported on mill certificates.
<input checked="" type="checkbox"/>	<b>h.</b> Inspect welding of reinforcing steel.	<b>Continuous</b>	<b>SI</b>	<b>Table 1705A.2.1 Item 5b, 1705A.3.1, Table 1705A.3 Item 2, 1903A.8;</b> AWS D1.4; DSA IR 17-3.

<b>20. NONDESTRUCTIVE TESTING:</b> <b>1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16</b>				
	<b>Test or Special Inspection</b>	<b>Type</b>	<b>Performed By</b>	<b>Code References and Notes</b>
<input checked="" type="checkbox"/>	<b>a.</b> Ultrasonic	<b>Test</b>	<b>LOR</b>	<b>1705A.2.1, 1705A.2.5;</b> AISC 341-16 J6.2, AISC 360-16 N5.5; ANSI/ASNT CP-189, SNT-TC-1A; AWS D1.1, AWS D1.8; DSA IR 17-2.

## DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS (Steel and Aluminum), 2019 CBC

1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16

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<input type="checkbox"/>	<b>b. Magnetic Particle</b>	<b>Test</b>	<b>LOR</b>	<b>1705A.2.1, 1705A.2.5;</b> AISC 341-16 J6.2, AISC 360-16 N5.5; ANSI/ASNT CP-189, SNT-TC-1A; AWS D1.1, AWS D1.8; DSA IR 17-2.
<input type="checkbox"/>	<b>c.</b>	<b>Test</b>	<b>LOR</b>	

<b>21. STEEL JOISTS AND TRUSSES: 1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16</b>				
	<b>Test or Special Inspection</b>	<b>Type</b>	<b>Performed By</b>	<b>Code References and Notes</b>
<input type="checkbox"/>	<b>a.</b> Verify size, type and grade for all chord and web members as well as connectors and weld filler material; verify joist profile, dimensions and camber (if applicable); verify all weld locations, lengths and profiles; mark or tag each joist.	<b>Continuous</b>	<b>SI</b>	<b>1705A.2.3, Table 1705A.2.3;</b> AWS D1.1; DSA IR 22-3 for steel joists only. <b>1705A.2.4;</b> AWS D1.3 for cold-formed steel trusses.

<b>22. SPRAY APPLIED FIRE-PROOFING: 1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16</b>				
	<b>Test or Special Inspection</b>	<b>Type</b>	<b>Performed By</b>	<b>Code References and Notes</b>
<input type="checkbox"/>	<b>a.</b> Examine structural steel surface conditions, inspect application, take samples, measure thickness and verify compliance of all aspects of application with DSA-approved documents.	<b>Periodic</b>	<b>SI</b>	<b>1705A.14.</b>
<input type="checkbox"/>	<b>b.</b> Test bond strength.	<b>Test</b>	<b>LOR</b>	<b>1705A.14.6.</b>

## DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS (Steel and Aluminum), 2019 CBC

1705A.2.1, Table 1705A.2.1; AISC 303-16, AISC 341-16, AISC 358-16, AISC 360-16; AISI S100-16

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<input type="checkbox"/>	c. Test density.	Test	LOR	1705A.14.5.
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	<b>23. ANCHOR BOLTS AND ANCHOR RODS:</b>			
	<b>Test or Special Inspection</b>	<b>Type</b>	<b>Performed By</b>	<b>Code References and Notes</b>
<input checked="" type="checkbox"/>	a. Anchor Bolts and Anchor Rods	Test	LOR	Sample and test anchor bolts and anchor rods not readily identifiable per procedures noted in DSA IR 17-11.
<input checked="" type="checkbox"/>	b. Threaded rod not used for foundation anchorage.	Test	LOR	Sample and test threaded rods not readily identifiable per procedures noted in DSA IR 17-11.

	<b>Other Steel</b>			
	<b>Test or Special Inspection</b>	<b>Type</b>	<b>Performed By</b>	<b>Code References and Notes</b>
<input type="checkbox"/>	a.			

## DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS (Other), 2019 CBC

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26. OTHER:				
	Test or Special Inspection	Type	Performed By	Code References and Notes
<input type="checkbox"/>	a. Load test for identified product(s):	Test	LOR	1709A.2, 1709A.3. Testing is not required for: 1) a product with a valid evaluation service report per DSA IR A-5, or 2) a product that can be justified by structural calculation.
<input type="checkbox"/>	b. Installation torque for non-HS bolts	Continuous	SI*	Applicable to communication towers identified as Essential Service Facility Projects (ESFP). Calibrated wrench use required, verified by SI during installation. DSA Policy PL 18-01: Communication Towers, Poles and Buildings Utilized by State Agencies for Essential Services Communications.*EXCEPTION: Non-ESFP may use PI without need for notification to DSA.
<input type="checkbox"/>	c.			

## Appendix: Work Exempt from DSA Requirements for Structural Tests / Special Inspections

<b>Application Number:</b> 02-119490	<b>School Name:</b> Davis Senior High School	<b>School District:</b> Davis Joint Unified School District
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Exempt items given in DSA IR A-22 or the 2019 CBC (including DSA amendments) and those items identified below with a check mark by the design professional are NOT subject to DSA requirements for the structural tests / special inspections noted. **Items marked as exempt shall be identified on the approved construction documents.** The project inspector shall verify all construction complies with the approved construction documents.

	<b>SOILS:</b>
<input type="checkbox"/>	1. Deep foundations acting as a cantilever footing designed based on minimum allowable pressures per CBC Table 1806A.2 and having no geotechnical report for the following cases: A) free standing sign or scoreboard, B) cell or antenna towers and poles less than 35'-0" tall (e.g., lighting poles, flag poles, poles supporting open mesh fences, etc.), C) single-story structure with dead load less than 5 psf (e.g., open fabric shade structure), or D) covered walkway structure with an apex height less than 10'-0" above adjacent grade.
<input type="checkbox"/>	2. Shallow foundations, etc. are exempt from special inspections and testing by a Geotechnical Engineer for the following cases: A) buildings without a geotechnical report and meeting the exception item #1 criteria in CBC Section 1803A.2 supported by native soil (any excavation depth) or fill soil (not exceeding 12" depth per CBC Section 1804A.6), B) soil scarification/recompaction not exceeding 12" depth, C) native or fill soil supporting exterior non-structural flatwork (e.g., sidewalks, site concrete ramps, site stairs, parking lots, driveways, etc.), D) unpaved landscaping and playground areas, or E) utility trench backfill.

	<b>CONCRETE/MASONRY:</b>
<input checked="" type="checkbox"/>	1. Post-installed anchors for the following: A) exempt non-structural components (e.g., mechanical, electrical, plumbing equipment - see item 7 for "Welding") given in CBC Section 1617A.1.18 (which replaces ASCE 7-16, Section 13.1.4) or B) interior nonstructural wall partitions meeting criteria listed in exempt item 3 for "Welding."
<input type="checkbox"/>	2. Concrete batch plant inspection is not required for items given in CBC Section 1705A.3.3.2 subject to the requirements and limitations in that section.

## Appendix: Work Exempt from DSA Requirements for Structural Tests / Special Inspections

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<input checked="" type="checkbox"/>	3. Non-bearing non-shear masonry walls may be exempt from certain DSA masonry testing and special inspection items as allowed per DSA IR 21-1.16. Refer to construction documents for specific exemptions accordingly for each applicable wall condition.
<input checked="" type="checkbox"/>	4. Epoxy shear dowels in site flatwork and/or other non-structural concrete.
<input checked="" type="checkbox"/>	5. Testing of reinforcing bars is not required for items given in CBC Section 1910A.2 subject to the requirements and limitations in that section.

	<b>Welding:</b>
<input checked="" type="checkbox"/>	1. Solid-clad and open-mesh gates with maximum leaf span or rolling section for rolling gates of 10' and apex height less than 8'-0" above lowest adjacent grade. When located above circulation or occupied space below, these gates are not located within 1.5x gate/fence height (max 8'-0") to the edge of floor or roof.
<input type="checkbox"/>	2. Handrails, guardrails, and modular or relocatable ramps associated with walking surfaces less than 30" above adjacent grade (excluding post base connections per the 'Exception' language in Section 1705A.2.1); fillet welds shall not be ground flush.
<input checked="" type="checkbox"/>	3. Non-structural interior cold-formed steel framing spanning less than 15'-0", such as in interior partitions, interior soffits, etc. supporting only self weight and light-weight finishes or adhered tile, masonry, stone, or terra cotta veneer no more than 5/8" thickness and apex less than 20'-0" in height and not over an exit way. Maximum tributary load to a member shall not exceed the equivalent of that occurring from a 10'x10' opening in a 15' tall wall for a header or king stud.
<input type="checkbox"/>	4. Manufactured support frames and curbs using hot rolled or cold-formed steel (i.e., light gauge) for mechanical, electrical, or plumbing equipment weighing less than 2000# (equipment only) (connections of such frames to superstructure elements using welding will require special inspection as noted in selected item(s) for Sections 19, 19.1 and/or 19.2 of listing above).
<input type="checkbox"/>	5. Manufactured components (e.g., Tolco, B-Line, Afcon, etc.) for mechanical, electrical, or plumbing hanger support and bracing (connections of such components to superstructure elements using welding will require special inspection as noted in selected item(s) for Sections 19, 19.1 and/or 19.2 of listing above).

## Appendix: Work Exempt from DSA Requirements for Structural Tests / Special Inspections

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<input type="checkbox"/>	6. TV Brackets, projector mounts with a valid listing (see DSA IR A-5) and recreational equipment (e.g., playground structures, basketball backstops, etc.) (connections of such elements to superstructure elements using welding will require special inspection as noted in selected item(s) for section 19, 19.1 and/or 19.2 located in the Steel/Aluminum category).
<input checked="" type="checkbox"/>	7. Any support for exempt non-structural components given in CBC Section 1617A.1.18 (which replaces ASCE 7-16, Section 13.1.4) meeting the following: A) when supported on a floor/roof, <400# and resulting composite center of mass (including component's center of mass) $\leq 4'$ above supporting floor/roof, B) when hung from a wall or roof/floor, <20# for discrete units or <5 plf for distributed systems.

## DSA 103-19: LISTING OF STRUCTURAL TESTS & SPECIAL INSPECTIONS(SIGNATURE), 2019 CBC

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Name of Architect or Engineer in general responsible charge:

Anthony Harris

Name of Structural Engineer (When structural design has been delegated):

Patrick Tabuchi

Signature of Architect or Structural Engineer:



Date:

October 25, 2021

**Note:** To facilitate DSA electronic mark-ups and identification stamp application, DSA recommends against using secured electronic or digital signatures.

**DSA STAMP**

## DSA 103-19: LIST OF REQUIRED VERIFIED REPORTS, CBC 2019

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1. Soils Testing and Inspection: Geotechnical Verified Report Form DSA 293

2. Structural Testing and Inspection: Laboratory Verified Report Form DSA 291

3. Concrete Batch Plant Inspection: Laboratory Verified Report Form DSA 291

4. Post-installed Anchors: Laboratory Verified Report Form DSA 291, or, for independently contracting SI, Special Inspection Verified Report Form DSA 292

5. Masonry Inspection: Laboratory Verified Report Form DSA 291, or, for independently contracting SI, Special Inspection Verified Report Form DSA 292

6. Shop Welding Inspection: Laboratory Verified Report Form DSA 291, or, for independently contracting SI, Special Inspection Verified Report Form DSA 292

7. Field Welding Inspection: Laboratory Verified Report Form DSA 291, or, for independently contracting SI, Special Inspection Verified Report Form DSA 292

8. High-Strength Bolt Installation Inspection: Laboratory Verified Report Form DSA 291, or, for independently contracting SI, Special Inspection Verified Report Form DSA 292

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## SECTION 01 5000 TEMPORARY FACILITIES AND CONTROLS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Dewatering
- B. Temporary utilities.
- C. Temporary telecommunications services.
- D. Temporary sanitary facilities.
- E. Temporary Controls: Barriers, enclosures, and fencing.
- F. Security requirements.
- G. Vehicular access and parking.
- H. Waste removal facilities and services.
- I. Project identification sign.
- J. Field offices.

#### 1.02 REFERENCE STANDARDS

#### 1.03 DEWATERING

- A. Provide temporary means and methods for dewatering all temporary facilities and controls.

#### 1.04 TEMPORARY UTILITIES

- A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.

#### 1.05 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:
  - 1. Telephone Land Lines: One line, minimum; one handset per line.
  - 2. Internet Connections: Minimum of one; DSL modem or faster.

#### 1.06 TEMPORARY SANITARY FACILITIES

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

#### 1.07 BARRIERS

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

#### 1.08 FENCING

- A. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

#### 1.09 SECURITY - SEE SECTION 01 3553

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

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#### **1.10 VEHICULAR ACCESS AND PARKING - SEE SECTION 01 5500**

- A. Coordinate access and haul routes with governing authorities and Owner.
- B. Provide and maintain access to fire hydrants, free of obstructions.
- C. Provide means of removing mud from vehicle wheels before entering streets.
- D. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

#### **1.11 WASTE REMOVAL**

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

#### **1.12 PROJECT IDENTIFICATION**

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

#### **1.13 FIELD OFFICES**

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Provide separate private office similarly equipped and furnished, for use of the project inspector.
- D. Locate offices a minimum distance of 30 feet from existing and new structures.

#### **1.14 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS**

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.

#### **PART 2 PRODUCTS - NOT USED**

#### **PART 3 EXECUTION - NOT USED**

**END OF SECTION 01 5000**

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## SECTION 01 5639 TEMPORARY TREE AND PLANT PROTECTION

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. Tree protection of existing trees and plants
- B. Tree pruning of existing trees

#### 1.02 RELATED REQUIREMENTS

- A. Division 01 Section - Temporary Facilities and Controls
- B. Division 31 Section - Site Clearing
- C. Division 32 Section - Landscape Work

#### 1.03 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape or the average of the smallest and largest diameters at 6 inches (150 mm) above the ground for trees up to, and including, 4-inch (100-mm) size; and 12 inches (300 mm) above the ground for trees larger than 4-inch (100-mm) size.
- B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

#### 1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of the following:
  - 1. Organic Mulch: 1-pint (0.5-L) 1-quart (1-L) volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
  - 2. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.
  - 3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.
- C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
  - 1. Species and size of tree.
  - 2. Location on site plan. Include unique identifier for each.
  - 3. Reason for pruning.
  - 4. Description of pruning to be performed.
  - 5. Description of maintenance following pruning.
- D. Qualification Data: For qualified arborist and tree service firm.
- E. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- F. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- G. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
  - 1. Use sufficiently detailed photographs or videotape.
  - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

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## 1.05 QUALITY ASSURANCE

- A. Arborist Qualifications:
  - 1. Certified Arborist as certified by ISA.
  - 2. Licensed Arborist in jurisdiction where Project is located.
- B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.
- C. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
    - a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
    - b. Enforcing requirements for protection zones.
    - c. Arborist's responsibilities.
    - d. Contractor responsibilities
    - e. Field quality control.

## 1.06 PROJECT CONDITIONS

- A. The following practices are prohibited within 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.
  - 6. Excavation or trenching or digging unless otherwise indicated.
  - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
  - 8. Do not direct vehicle or equipment exhaust toward protection zones.
  - 9. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch (25 mm) Insert dimension in diameter; and free of weeds, roots, and toxic and other nonsoil materials.
  - 1. Obtain topsoil only from well-drained sites where topsoil is 4 inches (100 mm) deep or more; do not obtain from bogs or marshes.
  - 2. Refer to Section 32 Landscape Work for material requirements.
- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
  - 1. Type: Wood and bark chips.
  - 2. Size Range: 1-1/2" inch minimum, 3" maximum.
  - 3. Color: Natural.
- C. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements. Previously used materials may be used when approved by Architect.

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1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch (50-mm) opening, 0.148-inch- (3.76-mm-) diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- (60-mm-) OD line posts, and 2-7/8-inch- (73-mm-) OD corner and pull posts; with 1-5/8-inch- (42-mm-) OD top rails and 0.177-inch- (4.5-mm-) diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
  - a. Height: 6 feet (1.8 m).
  - b. Galvanized
  - c. Polymer-Coating Color: Black.
2. Gates: Single swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches (914 mm) .
- D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes pre-punched and reinforced; legibly printed with nonfading lettering and as follows:
  1. Size: as required
  2. Text: "TREE PROTECTION ZONE - KEEP OUT. No unauthorized entry. No storage of vehicles, materials, or debris. No dumping of chemicals, slurry, paint, oil, etc. "
  3. Lettering: 3-inch (75-mm-)high minimum, black characters on white background.

### **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 protection zones.
- B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

#### **3.02 PREPARATION**

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag - Tie a 1-inch (25-mm) blue-vinyl tape around each tree trunk at 54 inches (1372 mm) above the ground.
- B. 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.
- C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated.
  1. Apply 3-inch (76-mm) average thickness of organic mulch. Do not place mulch within 6 inches (152 mm) of tree trunks.

#### **3.03 TREE- AND PLANT-PROTECTION ZONES**

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
  1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
  2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
  3. Access Gates: Install as required; adjust to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

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- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 35 feet (10.5 m) on protection-zone fencing, but no fewer than four signs with each facing a different direction.
- C. Maintain protection zones free of weeds and trash.
- D. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
- E. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
  - 1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
  - 2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

### 3.04 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Division 31 Section "Earth Moving."
- B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only roots smaller than 2" in diameter that interfere with installation of utilities. Cut roots as required for root pruning.
- C. 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 (75 mm) back from new construction and as required for root pruning.
- D. 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 soil.

### 3.05 ROOT PRUNING

- A. Do Not prune any roots without written authorization from Arborist or Client.
- B. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:
  - 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
  - 2. Cut Ends: Do not paint cut root ends. Coat cut ends of roots more than 1-1/2 inches (38 mm) in diameter with emulsified asphalt or other coating formulated for use on damaged plant tissues as approved by the arborist.
  - 3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
  - 4. Cover exposed roots with burlap and water regularly.
  - 5. Backfill as soon as possible according to requirements in Division 31 Section "Grading"
- C. Root Pruning at Edge of Protection Zone: Prune roots 12 inches (300 mm) outside of the protection zone, by cleanly cutting all roots to the depth of the required excavation.
- D. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

### 3.06 CROWN PRUNING

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- A. Do not prune any branches without written authorization from Arborist or Client.
- B. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:
  - 1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
  - 2. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and the following:
    - a. Type of Pruning: Cleaning Thinning Raising Reduction.
  - 3. Cut branches with sharp pruning instruments; do not break or chop.
  - 4. Do not apply pruning paint to wounds.
- C. Chip removed branches and dispose of off-site.

### **3.07 REGRADING**

- A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.
  - 1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.
- C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- D. Minor Fill within Protection Zone: Where existing grade is 4 inches (50 mm) or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

### **3.08 FIELD QUALITY CONTROL**

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

### **3.09 REPAIR AND REPLACEMENT**

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
  - 1. Submit details of proposed root cutting and tree and shrub repairs.
  - 2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
  - 3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
  - 4. Perform repairs within 24 hours.
  - 5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Trees: Remove and replace trees indicated to remain that are more than 66 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
  - 1. Provide new trees of same size and species as those being replaced for each tree that measures 4 inches (100 mm) or smaller in caliper size.
  - 2. Provide one new tree(s) of 6-inch (150-mm) caliper size for each tree being replaced that measure more than 4 inches (100 mm) in caliper size.
    - a. Species: Species selected by Architect.
  - 3. Plant and maintain new trees as specified in Division 32 Section "Landscape Work"

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- C. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate 10 feet (3 m) beyond drip line and no closer than 36 inches (900 mm) to tree trunk. Drill 2-inch (50-mm-) diameter holes a minimum of 12 inches (300 mm) deep at 24 inches (600 mm) O.C. Backfill holes with an equal mix of native soil and sand.

### **3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS**

- A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

**END OF SECTION 01 5639**

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## SECTION 01 5713 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. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

#### 1.02 RELATED REQUIREMENTS

- A. Section 31 1000 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.
- B. Section 31 2200 - Grading: Temporary and permanent grade changes for erosion control.
- C. Storm Water Pollution Prevention Plan (SWPPP).

#### 1.03 REFERENCE STANDARDS

- A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus.
- B. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity..
- C. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
- D. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
- E. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile.
- F. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
- G. FHWA FLP-94-005 - Best Management Practices for Erosion and Sediment Control.
- H. USDA TR-55 - Urban Hydrology for Small Watersheds; USDA Natural Resources Conservation Service.

#### 1.04 PERFORMANCE REQUIREMENTS

- A. Comply with all requirements of the State of California General Permit, latest edition, for erosion and sedimentation control .
- B. Best Management Practices Standard: CASQA Stormwater BMP Handbook.
- C. Comply with the requirements of the project Storm Water Pollution Prevention Plan (SWPPP).
- D. 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 obtain permits and pay for securities required by authority having jurisdiction.
  - 2. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.
- E. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- F. 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.

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- G. 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.
- H. 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.
- I. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on 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.
  - 2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
- J. 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.
- K. Open Water: Prevent standing water that could become stagnant.
- L. Maintenance: Maintain temporary preventive measures until permanent measures have been established.
- M. Penalties and Fines: The Contractor is responsible for all penalties and fines assessed to or levied on the project related to stormwater management.

## **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Maintenance Instructions: Provide instructions covering inspection and maintenance for temporary measures that must remain after Substantial Completion.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Use materials that conform to California Stormwater Quality Association (CASQA) and the California Stormwater Best Management Practice (BMP) handbook, current edition.
- B. 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.

## **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**

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- A. The project SWPPP shall be prepared and electronically uploaded to the State Water Board's SMARTS system database by the District's Qualified SWPPP Developer (QSD), the District's Legally Responsible Person (LRP) or Approved Signatory (AS), or by a data submitter as designated by the District.
- B. The Contractor shall employ the services of a Qualified SWPPP Practitioner (QSP). The QSP shall download copies of the approved SWPPP from the State, and is responsible for implementation and enforcement of the SWPPP and the Erosion Control Plan. At least one (1) copy of the SWPPP shall be available at the site at all times.
- C. The QSP is responsible for training of personnel for proper implementation of the SWPPP, monitoring and all required reports.
- D. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

### **3.03 INSTALLATION**

- A. The Contractor shall implement preventative measures in accordance with the SWPPP and as required by the State Water Board.
- B. 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.

### **3.04 MAINTENANCE**

- A. Inspect preventive measures as required by the Storm Water Pollution Prevention Plan (SWPPP) and the State Water Board.
- B. Repair deficiencies immediately.
- C. Clean out temporary sediment control structures as needed and relocate soil on site.
- D. Place sediment in appropriate locations on site; do not remove from site.

### **3.05 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.

### **3.06 SWPPP CLOSE-OUT**

- A. Within 90 days of construction completion, the QSP shall electronically file a Notice of Termination (NOT) in the Stormwater Multiple Application and Report Tracking System (SMARTS) online.
- B. The QSP shall provide a Final Site Map for inclusion with the NOT. The Final Site map shall provide sufficient information, including photos, to demonstrate compliance with the Permit regarding final site stabilization. All photo locations and directions shall be identified on the Final Site Map. All photos shall be clearly labeled.

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C. The QSP is responsible for filing the Annual Report.

**END OF SECTION 01 5713**

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## SECTION 01 6000 PRODUCT REQUIREMENTS

### PART 1 GENERAL

#### 1.01 RELATED REQUIREMENTS

- A. Section 01 2500 - Substitution Procedures: Substitutions made during and after the Bidding/Negotiation Phase.
- B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

#### 1.02 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
  - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

### PART 2 PRODUCTS

#### 2.01 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.
- B. DO NOT USE products having any of the following characteristics:
  - 1. Contain asbestos or lead-base paint:
    - a. No materials may be used in this project or in any tools, devices, clothing or equipment used to affect this construction that contain asbestos or lead-based paint. All work or materials found to contain asbestos or lead-base paint, or material installed with asbestos containing equipment or lead-base paint will be immediately rejected and this work will be removed by a certified EPA hazard material Contractor under the supervision of a certified hazard material consultant at no additional cost to Owner.
    - b. Contractor and subcontractors shall certify that no asbestos containing materials and no lead-base paint were used in this project. Certification letter must be addressed to Owner, including project and Contractors' information; to be notarized.
- C. Where all other criteria are met, Contractor shall give preference to products that:
  - 1. If used on interior, have lower emissions, as defined in Section 01 6116.
  - 2. If wet-applied, have lower VOC content, as defined in Section 01 6116.
  - 3. Have a published GreenScreen Chemical Hazard Analysis.

#### 2.02 PRODUCT OPTIONS

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

### PART 3 EXECUTION

#### 3.01 SUBSTITUTION LIMITATIONS

- A. See Section 01 2500 - Substitution Procedures.

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- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- C. A request for substitution constitutes a representation that the submitter:
  - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
  - 2. Agrees to provide the same warranty for the substitution as for the specified product.
  - 3. Agrees to coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Architect.
  - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
  - 5. Will obtain necessary approval of agencies having jurisdiction.
- D. Construction Document Revisions
  - 1. Should a Contractor-proposed substitution or alternative sequence or method of construction require revision of the Contract Drawings or Specifications, including revisions
  - 2. for the purposes of determining feasibility, scope or cost, or revisions for the purpose of obtaining review and approval by authorities having jurisdiction, revisions will be made by Architect or other consultant of the District who is the responsible design professional, as approved in advance by District's Representative.
  - 3. Services of Architect, other responsible design professionals and District for researching and reporting on proposed substitutions or alternative sequence and method of construction shall be paid by Contractor when such activities are considered additional services to the design services contracts of Architect or other responsible design professional with District.
  - 4. Costs of services by Architect, other responsible design professionals and District shall be paid, including travel, reproduction, long distance telephone and shipping costs reimbursable at cost plus usual and customary mark-up for handling and billing.
  - 5. Such fees shall be paid whether or not the proposed substitution or alternative sequence or method of construction is ultimately accepted by District and a Change Order is executed.
  - 6. Such fees shall be paid from Contractor's portion of savings, if a net reduction in Contract Sum results. If fees exceed Contractor's portion of net reduction, Contractor shall pay all remaining fees unless otherwise agreed in advance by District's Representative.

### **3.02 TRANSPORTATION AND HANDLING**

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

### **3.03 STORAGE AND PROTECTION**

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- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- G. Comply with manufacturer's warranty conditions, if any.
- H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- I. Prevent contact with material that may cause corrosion, discoloration, or staining.
- J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

**END OF SECTION 01 6000**

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## SECTION 01 6116 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.
- C. Requirement for installer certification that they did not use any non-compliant products.

#### 1.02 RELATED REQUIREMENTS

- A. Section 01 3000 - Administrative Requirements: Submittal procedures.

#### 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.
- 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.
  - 3. Other products when specifically stated in the specifications.
- 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.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.
- C. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers.
- D. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; California Air Resources Board.
- E. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

Volatile Organic Compound (VOC) Content Restrictions	01 6116 - 1
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- F. CHPS (HPPD) - High Performance Products Database.
- G. CRI (GLP) - Green Label Plus Testing Program - Certified Products.
- H. SCAQMD 1113 - Architectural Coatings.
- I. SCAQMD 1168 - Adhesive and Sealant Applications.
- J. SCS (CPD) - SCS Certified Products.
- K. UL (GGG) - GREENGUARD Gold Certified Products.

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.
- C. Installer Certifications Regarding Prohibited Content: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either 1) no adhesives, joint sealants, paints, coatings, or composite wood or agrifiber products have been used in the installation of installer's products, or 2) that such products used comply with these requirements.

#### 1.06 QUALITY ASSURANCE

- A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
  - 1. Wet-Applied Products: State amount applied in mass per surface area.
  - 2. Paints and Coatings: Test tinted products, not just tinting bases.
  - 3. Evidence of Compliance: Acceptable types of evidence are the following;
    - a. Current UL (GGG) certification.
    - b. Current SCS (CPD) Floorscore certification.
    - c. Current SCS (CPD) Indoor Advantage Gold certification.
    - d. Current listing in CHPS (HPPD) as a low-emitting product.
    - e. Current CRI (GLP) certification.
    - f. Test report showing compliance and stating exposure scenario used.
  - 4. Product data submittal showing VOC content is NOT acceptable evidence.
  - 5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.
- B. 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.
- C. Composite Wood Emissions Standard: CARB (ATCM) for ultra-low emitting formaldehyde (ULEF) resins.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Current SCS "No Added Formaldehyde (NAF)" certification; [www.scs-certified.com](http://www.scs-certified.com).
    - b. Report of laboratory testing performed in accordance with requirements.
    - c. Published product data showing compliance with requirements.
- D. 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. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.

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- B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
  - 1. Composite Wood, Wood Fiber, and Wood Chip Products: Comply with Composite Wood Emissions Standard or contain no added formaldehyde resins.
  - 2. Inherently Non-Emitting Materials.
- C. 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).

### **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 01 6116**

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## SECTION 01 7000 EXECUTION AND CLOSEOUT REQUIREMENTS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Surveying for laying out the work.
- F. Cleaning and protection.
- G. Starting of systems and equipment.
- H. Demonstration and instruction of Owner personnel.
- I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

#### 1.02 REFERENCE STANDARDS

#### 1.03 QUALIFICATIONS

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

#### 1.04 PROJECT CONDITIONS

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- C. Perform dewatering activities, as required, for the duration of the project.
- D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- E. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
- F. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
  - 1. Minimize amount of bare soil exposed at one time.
  - 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
  - 3. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- G. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- H. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

#### 1.05 COORDINATION

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

## **PART 2 PRODUCTS**

### **2.01 PATCHING MATERIALS**

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations. Furnish information to local utility and Owner where necessary to adjust, move, or relocate existing utilities and appertenances.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

### **3.02 PREPARATION**

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

### **3.03 PREINSTALLATION MEETINGS**

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

#### **3.04 LAYING OUT THE WORK**

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Contractor shall locate and protect survey control and reference points.
- D. Control datum for survey is that established by Owner provided survey.
- E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- F. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- H. Utilize recognized engineering survey practices.
- I. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
  - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
  - 2. Grid or axis for structures.
- J. Periodically verify layouts by same means.
- K. Maintain a complete and accurate log of control and survey work as it progresses.

#### **3.05 GENERAL INSTALLATION REQUIREMENTS**

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

#### **3.06 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 indicated.
  - 2. Report discrepancies to Architect before disturbing existing installation.
  - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
  - 1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.

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2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- C. Remove existing work as indicated and as required to accomplish new work.
  1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
  2. Remove items indicated on drawings.
  3. Relocate items indicated on drawings.
  4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
  5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and Fire Water): Remove, relocate, and extend existing systems to accommodate new construction.
  1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
  2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
  3. 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.
    - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
    - b. Provide temporary connections as required to maintain existing systems in service.
  4. Verify that abandoned services serve only abandoned facilities.
  5. 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; patch holes left by removal using materials specified for new construction.
- E. 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.
- F. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
  1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
  2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
  3. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
- G. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- H. Refinish existing surfaces as indicated:
  1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.

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2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- I. Clean existing systems and equipment.
- J. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- K. Do not begin new construction in alterations areas before demolition is complete.
- L. Comply with all other applicable requirements of this section.

### 3.07 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
  1. Complete the work.
  2. Fit products together to integrate with other work.
  3. Provide openings for penetration of mechanical, electrical, and other services.
  4. Match work that has been cut to adjacent work.
  5. Repair areas adjacent to cuts to required condition.
  6. Repair new work damaged by subsequent work.
  7. Remove samples of installed work for testing when requested.
  8. Remove and replace defective and non-complying work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.
- J. Patching:
  1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
  2. Match color, texture, and appearance.
  3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

### 3.08 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

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### **3.09 PROTECTION OF INSTALLED WORK**

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

### **3.10 SYSTEM STARTUP**

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

### **3.11 DEMONSTRATION AND INSTRUCTION**

- A. See Section 01 7900 - Demonstration and Training.
- B. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- D. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.

### **3.12 ADJUSTING**

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

### **3.13 FINAL CLEANING**

- A. Execute final cleaning after Substantial Completion but before making final application for payment.
- B. Use cleaning materials that are nonhazardous.
- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Clean filters of operating equipment.

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- G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

### **3.14 CLOSEOUT PROCEDURES**

- A. Make submittals that are required by governing or other authorities.
- B. Substantial Completion
  - 1. Prepare and submit a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
    - a. Advise Owner of pending insurance changeover requirements.
    - b. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
    - c. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
    - d. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
    - e. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
    - f. Complete startup testing of systems.
    - g. Submit test/adjust/balance records.
    - h. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
    - i. Advise Owner of changeover in heat and other utilities.
    - j. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
    - k. Complete final cleaning requirements, including touchup painting.
  - 2. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
    - a. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
  - 3. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
  - 4. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- C. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- D. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

### **3.15 FINAL COMPLETION**

- A. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- B. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

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- C. Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will notify Contractor of construction that must be completed or corrected.
  - 1. Following completion of all final inspection items, Contactor shall prepare and submit a final Certificate for Payment.

### **3.16 MAINTENANCE**

**END OF SECTION 01 7000**

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## SECTION 01 7419 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

### PART 1 GENERAL

#### 1.01 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports. See form CWM-1 on Section 017419.01
- E. Methods of trash/waste disposal that are not acceptable are:
  - 1. Burning on the project site.
  - 2. Burying on the project site.
  - 3. Dumping or burying on other property, public or private.
  - 4. Other illegal dumping or burying.
  - 5. Incineration, either on- or off-site.
- F. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

#### 1.02 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

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- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

### **1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
  - 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
  - 2. Submit Report on a form acceptable to Owner.
  - 3. Recycled and Salvaged Materials: Include the following information for each:
    - a. Identification of material, including those retrieved by installer for use on other projects.
    - b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
    - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
    - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
    - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
  - 4. Material Reused on Project: Include the following information for each:
    - a. Identification of material and how it was used in the project.
    - b. Amount, in tons or cubic yards.
    - c. Include weight tickets as evidence of quantity.
  - 5. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

## **PART 2 PRODUCTS**

### **2.01 PRODUCT SUBSTITUTIONS**

- A. See Section 01 6000 - Product Requirements for substitution submission procedures.

## **PART 3 EXECUTION**

### **3.01 WASTE MANAGEMENT PLAN IMPLEMENTATION**

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
  - 1. Provide containers as required.
  - 2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
  - 3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- E. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

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- F. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- G. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- H. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

**END OF SECTION 01 7419**

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FORM CWM-1: CONSTRUCTION WASTE IDENTIFICATION							
MATERIAL CATEGORY	GENERATION POINT	EST. QUANTITY OF MATERIALS RECEIVED*	EST. WASTE (%)	TOTAL EST. QUANTITY OF WASTE*	EST. VOLUME CY (CM)	EST. WEIGHT TONS (TONNES)	REMARKS AND ASSUMPTIONS
		(A)	(B)	(C = A x B)			
Packaging: Cardboard							
Packaging: Boxes							
Packaging: Plastic Sheet or Film							
Packaging: Polystyrene							
Packaging: Pallets or Skids							
Packaging: Crates							
Packaging: Paint Cans							
Packaging: Plastic Pails							
Site-Clearing Waste							
Masonry or CMU							
Offs							
Lumber: Warped Pieces							
Plywood or OSB (scraps)							
Wood Forms							
Wood Waste Chutes							
Wood Trim (cut-offs)							
Metals							
Insulation							
Roofing							
Joint Sealant Tubes							
Gypsum Board (scraps)							
Carpet and Pad (scraps)							
Piping							
Electrical Conduit							
Other:							

\* Insert units of measure

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## SECTION 01 7800 CLOSEOUT SUBMITTALS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

#### 1.02 RELATED REQUIREMENTS

- A. Section 00 7200 - General Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.
- B. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- C. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.
- D. Individual Product Sections: Specific requirements for operation and maintenance data.
- E. Individual Product Sections: Warranties required for specific products or Work.

#### 1.03 SUBMITTALS

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

### PART 2 PRODUCTS - NOT USED

### PART 3 EXECUTION

#### 3.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
  - 1. Drawings.
  - 2. Specifications.
  - 3. Addenda.
  - 4. Change Orders and other modifications to the Contract.
  - 5. Reviewed shop drawings, product data, and samples.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.

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- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
  - 1. Manufacturer's name and product model and number.
  - 2. Product substitutions or alternates utilized.
  - 3. Changes made by Addenda and modifications.
- F. Record Drawings: Legibly mark each item to record actual construction including:
  - 1. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  - 2. Field changes of dimension and detail.
  - 3. Details not on original Contract drawings.

### **3.02 OPERATION AND MAINTENANCE DATA**

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

### **3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES**

- A. For Each Product, Applied Material, and Finish:
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

### **3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS**

- A. For Each Item of Equipment and Each System:
  - 1. Description of unit or system, and component parts.
  - 2. Identify function, normal operating characteristics, and limiting conditions.
  - 3. Include performance curves, with engineering data and tests.
  - 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
  - 1. Include Carbon Dioxide Monitoring Protocol.
  - 2. Include Carbon Monoxide Monitoring Protocol.
- E. Provide servicing and lubrication schedule, and list of lubricants required.
- F. Include manufacturer's printed operation and maintenance instructions.

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- G. Include sequence of operation by controls manufacturer.
- H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- I. Provide control diagrams by controls manufacturer as installed.
- J. Additional Requirements: As specified in individual product specification sections.

### **3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS**

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

### **3.06 WARRANTIES AND BONDS**

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

**END OF SECTION 01 7800**

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## SECTION 01 7900 DEMONSTRATION AND TRAINING

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
  - 1. All software-operated systems.
  - 2. HVAC systems and equipment.
  - 3. Plumbing equipment.
  - 4. Electrical systems and equipment.

#### 1.02 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures; except:
  - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
  - 2. Submit one copy to the Commissioning Authority, not to be returned.
  - 3. Make commissioning submittals on time schedule specified by Commissioning Authority.
  - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, Microsoft Word 2003 preferred.
- B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
  - 1. Submit to Commissioning Authority for review and inclusion in overall training plan.
  - 2. Submit not less than four weeks prior to start of training.
  - 3. Revise and resubmit until acceptable.
  - 4. Provide an overall schedule showing all training sessions.
  - 5. Include at least the following for each training session:
    - a. Identification, date, time, and duration.
    - b. Description of products and/or systems to be covered.
    - c. Name of firm and person conducting training; include qualifications.
    - d. Intended audience, such as job description.
    - e. Objectives of training and suggested methods of ensuring adequate training.
    - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
    - g. Media to be used, such as slides, hand-outs, etc.
    - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
  - 1. Include applicable portion of O&M manuals.
  - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
  - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.

#### 1.03 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
  - 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
  - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

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## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 DEMONSTRATION - GENERAL**

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
  - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
  - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
  - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

### **3.02 TRAINING - GENERAL**

- A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.
- B. Conduct training on-site unless otherwise indicated.
- C. Owner will provide classroom and seating at no cost to Contractor.
- D. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.
- E. Provide training in minimum two hour segments.
- F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.
- G. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
  - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
  - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
  - 3. Typical uses of the O&M manuals.
- I. Product- and System-Specific Training:
  - 1. Review the applicable O&M manuals.
  - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
  - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
  - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
  - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
  - 6. Discuss common troubleshooting problems and solutions.
  - 7. Discuss any peculiarities of equipment installation or operation.

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8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
  9. Review recommended tools and spare parts inventory suggestions of manufacturers.
  10. Review spare parts and tools required to be furnished by Contractor.
  11. Review spare parts suppliers and sources and procurement procedures.
- J. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

**END OF SECTION 01 7900**

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## SECTION 01 9113 GENERAL COMMISSIONING REQUIREMENTS

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Commissioning is intended to achieve the following specific objectives; this section specifies the Contractor's responsibilities for commissioning:
  - 1. Verify that the work is installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists executed by Contractor are utilized to achieve this.
  - 2. Verify and document that functional performance is in accordance with the Contract Documents: Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
  - 3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this.
  - 4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is utilized to achieve this.
- B. The Commissioning Authority directs and coordinates all commissioning activities; this section describes some but not all of the Commissioning Authority's responsibilities.

#### 1.02 SCOPE OF COMMISSIONING

- A. The following are to be commissioned:
- B. Plumbing Systems:
  - 1. Water heaters.
  - 2. Booster pumps.
  - 3. Pool equipment.
- C. Electronic Safety and Security:
  - 1. Security system, including doors and hardware.
- D. Communications:
  - 1. Voice and data systems.
- E. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

#### 1.03 RELATED REQUIREMENTS

- A. Section 01 7800 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures; except:
  - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority, unless they require review by Architect; in that case, submit to Architect first.
  - 2. Submit one copy to the Commissioning Authority, not to be returned.
  - 3. Make commissioning submittals on time schedule specified by Commissioning Authority.
  - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of Prefunctional Checklists or Functional Test requirements; submit in editable electronic format, Microsoft Word 2010 preferred.
  - 5. As soon as possible after submittals made to Architect are approved, submit copy of approved submittal to the Commissioning Authority.
- B. Product Data: If submittals to Architect do not include the following, submit copies as soon as possible:

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1. Manufacturer's product data, cut sheets, and shop drawings.
  2. Manufacturer's installation instructions.
  3. Startup, operating, and troubleshooting procedures.
  4. Fan and pump curves.
  5. Factory test reports.
  6. Warranty information, including details of Owner's responsibilities in regard to keeping warranties in force.
- C. Manufacturers' Instructions: Submit copies of all manufacturer-provided instructions that are shipped with the equipment as soon as the equipment is delivered.
- D. Startup Plans and Reports.
- E. Completed Prefunctional Checklists.

## **PART 2 PRODUCTS**

### **2.01 TEST EQUIPMENT**

- A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F and resolution of plus/minus 0.1 degree F.
  2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.
  3. Calibration: According to the manufacturer's recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.
- C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.
- D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of Owner.

## **PART 3 EXECUTION**

### **3.01 COMMISSIONING PLAN**

- A. Commissioning Authority has prepared the Commissioning Plan.
1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
  2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.
- B. Contractor is responsible for compliance with the Commissioning Plan.
- C. Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.
- D. Commissioning Schedule:
1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
  2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.

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3. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

### **3.02 STARTUP PLANS AND REPORTS**

- A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.
- B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.
- C. Submit directly to the Commissioning Authority.

### **3.03 PREFUNCTIONAL CHECKLISTS**

- A. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
  1. No sampling of identical or near-identical items is allowed.
  2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
  3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
    - a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
    - b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
    - c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
    - d. Serial number of installed unit.
    - e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer's start-up checklist items and minor testing.
    - f. Sensor and actuator calibration information.
- B. Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
  1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.
  2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
  3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
  4. If any Checklist line item is not relevant, record reasons on the form.
  5. Contractor may independently perform startup inspections and/or tests, at Contractor's option.
  6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
  7. Submit completed Checklists to Commissioning Authority within two days of completion.
- C. Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.

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1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in the Contract Documents.
  2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
  3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in the Contract Documents or not.
  4. When asked to review the proposed Checklists, do so in a timely manner.
- D. Commissioning Authority Witnessing: Required for:
1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
  2. A sampling of non-primary equipment, as allowed by the commissioning plan.
- E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

### 3.04 FUNCTIONAL TESTS

- A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.
- B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.
- C. Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.
- D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to Owner; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents or does not perform properly.
  2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.
  3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
  4. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing.
  5. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.
- E. Functional Test Procedures:
1. Some test procedures are included in the Contract Documents; where Functional Test procedures are not included in the Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
  2. Examples of Functional Testing:

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- a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods 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).
  - b. 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.
  - c. Systems are run through all the HVAC control system's sequences of operation and components are verified to be responding as the sequence's state.
  - d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.
- F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

### 3.05 SENSOR AND ACTUATOR CALIBRATION

- A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gauges, 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 Commissioning Authority and Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional 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 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 of the site sensor.
  - 2. Verify that the sensor reading, via the permanent thermostat, gauge 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 comply with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
  - 8. Reconnect sensor.

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9. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
  10. Verify that the sensor reading, via the permanent thermostat, gauge 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, Duct Air): 0.4 degrees F.
  4. Relative Humidity: 4 percent of design.
  5. Barometric Pressure: 0.1 inch of Hg.
  6. Flow Rate, Air: 10 percent of design.
  7. Flow Rate, Water: 4 percent of design.
  8. AHU Wet Bulb and Dew Point: 2.0 degrees F.
- 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 or add pilot positioner (for pneumatics).
- 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.

### 3.06 TEST PROCEDURES - GENERAL

- A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
- B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.
- C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
  2. Sampling is not allowed for:
    - a. Major equipment.
    - b. Life-safety-critical equipment.
    - c. Prefunctional Checklist execution.
  3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
  4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.

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5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
  6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
  7. If YY percent of the units in the second sample fail, test all remaining identical units.
  8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.
- D. Manual Testing: Use 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").
  - E. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.
  - F. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.
  - G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.
  - H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.
  - I. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
    1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority's request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
    2. Other points will be monitored by the Commissioning Authority using dataloggers.
    3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
    4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
    5. Graphical output is desirable and is required for all output if the system can produce it.
    6. Monitoring may be used to augment manual testing.

### **3.07 OPERATION AND MAINTENANCE MANUALS**

- A. See Section 01 7800 - Closeout Submittals for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

**END OF SECTION 01 9113**

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## SECTION 02 4100 DEMOLITION

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Selective demolition of building elements for alteration purposes.

#### 1.02 REFERENCE STANDARDS

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Site Plan: Showing:
  - 1. Areas for temporary construction and field offices.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

### PART 3 EXECUTION

#### 2.01 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
  - 1. Obtain required permits.
  - 2. Use of explosives is not permitted.
  - 3. 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.
  - 4. Provide, erect, and maintain temporary barriers and security devices.
  - 5. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
  - 6. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
  - 7. Do not close or obstruct roadways or sidewalks without permit.
  - 8. 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.
  - 9. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Protect existing structures and other elements that are not to be 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.
- C. 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.
- D. 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.

#### 2.02 EXISTING UTILITIES

- 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.

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- 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.

### **2.03 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 indicated.
  - 2. Report discrepancies to Architect before disturbing existing installation.
  - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- 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; 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.

### **2.04 DEBRIS AND WASTE REMOVAL**

- 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 7419 - 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 02 4100**

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## SECTION 03 0516 UNDERSLAB VAPOR BARRIER - STEGO

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Sheet vapor barrier under concrete slabs on grade.

#### 1.02 RELATED REQUIREMENTS

- A. Section 03 1000 - Concrete Forming and Accessories: Forms and accessories for formwork.
- B. Section 03 2000 - Concrete Reinforcing.
- C. Section 03 3000 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.
- D. Section 071300 - Sheet Waterproofing: Below-grade waterproofing.

#### 1.03 REFERENCE STANDARDS

- A. ACI 302.2R-06: Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
- B. ACI 302.1R-15: Guide to Concrete Floor and Slab Construction.
- C. 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.
- D. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products.
- C. Test Data: Submit report of tests showing compliance with specified requirements and paragraph 9.3 of ASTM E1745.
- D. Samples: Submit samples of underslab vapor barrier to be used.
- E. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction per ASTM E1643.
- F. All mandatory ASTM E1745 testing must be performed on a single production roll per ASTM E1745 Section 8.1.
- G. Contact vapor barrier manufacturer to schedule a pre-construction meeting and to coordinate a review, in-person or digital, of the vapor barrier installation.
- H. Vapor barrier manufacturer must warrant in writing (a) compliance with the designated ASTM E1745 classification, and (b) no manufacturing defects in the product for, at least, the Life of the Building.
- I. Manufacturer verify in writing a 20-year track record of the selected vapor barrier with no reported product failures.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. Underslab Vapor Barrier:
  - 1. Water Vapor Permeance: Not more than 0.010 perms, maximum, as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
  - 2. Strength complying with ASTM E1745 Class A.
  - 3. Thickness: 15 mils.
  - 4. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745 Section 8.1

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5. Warranty: (a) compliance with the designated ASTM E1745 classification, and (b) no manufacturing defects in the product for, at least, the Life of the Building.
6. Basis of Design:
  - a. Stego Industries LLC; Stego Wrap Vapor Barrier (15-mil):  
www.stegoindustries.com/#sle.
  - b. Approved Alternate: Vaporguard by Reef Industries, 713-507-4250.  
www.reefindustries.com..
  - c. Approved Alternate: PMPC by WR Meadows, 800-342-5976.  
http://www.wrmeadows.com/pmpc.
- B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.
  1. Seams:
    - a. Stego Tape by Stego Industries LLC, (877) 464-7834  
www.stegoindustries.com .
  2. Sealing Penetrations of Vapor barrier:
    - a. Stego Mastic by Stego Industries LLC, (877) 464-7834  
www.stegoindustries.com .
    - b. Stego Tape by Stego Industries LLC, (877) 464-7834  
www.stegoindustries.com .
  3. Perimeter/terminated edge seal:
    - a. Stego Crete Claw (textured tape) by Stego Industries LLC, (877) 464-7834  
www.stegoindustries.com .
    - b. Stego Term Bar by Stego Industries LLC, (877) 464-7834  
www.stegoindustries.com .
    - c. Stego Tack Tape (double-sided sealant tape) by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com .
    - d. One-sided seaming tape is not a recommended method of sealing at the terminated edge.
  4. Penetration Prevention:
    - a. Beast Foot by Stego Industries LLC, (877) 464-7834  
www.stegoindustries.com .

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.
- B. Contact vapor barrier manufacturer to schedule a pre-construction meeting and to coordinate a review, in-person or digital, of the vapor barrier installation.

#### **3.02 INSTALLATION**

- A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
  1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
  2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise (a) at a point acceptable to the structural engineer or (b) where obstructed by impediments, such as dowels, water stops, or any other site condition requiring early termination of the vapor barrier. At the point of termination, seal vapor barrier to the foundation wall, grade beam or slab itself.
    - a. Seal vapor barrier to the entire slab perimeter using manufacturer's textured tape with a surface that creates a mechanical seal to freshly-placed concrete, per manufacturer's instructions.

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- b. Seal vapor barrier to the entire perimeter wall or footing/grade beam with manufacturer's double-sided tape, or both termination bar and double-sided tape, per manufacturer's instructions. Ensure the concrete is clean and dry prior to adhering tape.
3. Overlap joints 6 inches and seal with manufacturer's seam tape.
4. Apply seam tape/textured tape/double-sided tape to a clean and dry vapor barrier.
5. Seal all penetrations (including pipes) per manufacturer's instructions.
6. Avoid the use of stakes driven through vapor barrier by utilizing screed and forming systems that will not leave punctures in the vapor barrier.
7. Repair damaged areas with vapor barrier material of similar (or better) permeance, puncture and tensile.

**END OF SECTION 03 0516**

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## SECTION 03 1000 CONCRETE FORMING AND ACCESSORIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Formwork for cast-in place concrete, with shoring, bracing and anchorage.
- B. Form stripping.

#### 1.02 RELATED REQUIREMENTS

- A. Section 03 2000 - Concrete Reinforcing.
- B. Section 03 3000 - Cast-in-Place Concrete.

#### 1.03 REFERENCE STANDARDS

- A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
- B. ACI 301 - Specifications for Concrete Construction.
- C. ACI 318 - Building Code Requirements for Structural Concrete.
- D. ACI 347R - Guide to Formwork for Concrete.
- E. PS 1 - Structural Plywood.

### 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. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

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

#### 3.02 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.

#### 3.03 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

**END OF SECTION 03 1000**

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## SECTION 03 2000 CONCRETE REINFORCING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.

#### 1.02 RELATED REQUIREMENTS

- A. Section 03 1000 - Concrete Forming and Accessories.
- B. Section 03 3000 - Cast-in-Place Concrete.
- C. Section 04 2000 - Unit Masonry: Reinforcement for masonry.
- D. Section 04 2613 - Masonry Veneer: Spacing for veneer anchor reglets recessed in concrete.

#### 1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Concrete Construction.
- B. ACI 318 - Building Code Requirements for Structural Concrete.
- C. CRSI (DA4) - Manual of Standard Practice.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

### PART 2 PRODUCTS

#### 2.01 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
  - 1. Plain billet-steel bars.
  - 2. Unfinished.
- B. Reinforcement Accessories:
  - 1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.
  - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
  - 3. Provide stainless steel components for placement within 1-1/2 inches of weathering surfaces.

#### 2.02 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.

### PART 3 EXECUTION

#### 3.01 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.

#### 3.02 FIELD QUALITY CONTROL

- A. An independent testing agency, as specified in Section 01 4000 - Quality Requirements, will inspect installed reinforcement for conformance to contract documents before concrete placement.

**END OF SECTION 03 2000**

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## SECTION 03 3000 CAST-IN-PLACE CONCRETE

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Floors and slabs on grade.
- B. Miscellaneous concrete elements, including equipment pads, equipment pits, light pole bases, flagpole bases, thrust blocks, and manholes.
- C. Concrete curing.

#### 1.02 RELATED REQUIREMENTS

- A. Section 03 1000 - Concrete Forming and Accessories: Forms and accessories for formwork.
- B. Section 03 2000 - Concrete Reinforcing.

#### 1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Concrete Construction.
- B. ACI 302.1R - Guide to Concrete Floor and Slab Construction.
- C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- D. ACI 308R - Guide to External Curing of Concrete.
- E. ACI 318 - Building Code Requirements for Structural Concrete.
- F. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
- G. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- H. ASTM C150/C150M - Standard Specification for Portland Cement.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Mix Design: Submit proposed concrete mix design.
  - 1. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
- C. Test Reports: Submit report for each test or series of tests specified.

#### 1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.

### PART 2 PRODUCTS

#### 2.01 REINFORCEMENT MATERIALS

- A. Comply with requirements of Section 03 2000.

#### 2.02 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
- B. Fine and Coarse Aggregates: ASTM C33/C33M.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

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

#### 3.02 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

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### 3.03 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.

### 3.04 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. 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.

### 3.05 CONCRETE FINISHING

- A. 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.

### 3.06 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.
- C. Surfaces Not in Contact with Forms:
  - 1. 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.
  - 2. Final Curing: Begin after initial curing but before surface is dry.

### 3.07 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. 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.
- D. Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, or not less than once for each 50 cubic yards (345 m3) of concrete, or not less than once for each 2,000 square feet (186 m2) of surface area for slabs or walls. Additional samples for 7-day compressive strength tests shall be taken for each class of concrete at the beginning of the concrete work or whenever the mix or aggregate is changed.

### 3.08 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

### 3.09 PROTECTION

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

**END OF SECTION 03 3000**

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## SECTION 04 0511 MORTAR AND MASONRY GROUT

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

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

#### 1.02 RELATED REQUIREMENTS

- A. Section 04 2000 - Unit Masonry: Installation of mortar and grout.
- B. Section 08 1113 - Hollow Metal Doors and Frames: Products and execution for grouting steel door frames installed in masonry.

#### 1.03 REFERENCE STANDARDS

- A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.
- B. ASTM C5 - Standard Specification for Quicklime for Structural Purposes.
- C. ASTM C91/C91M - Standard Specification for Masonry Cement.
- D. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
- E. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
- F. ASTM C150/C150M - Standard Specification for Portland Cement.
- G. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
- H. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
- I. ASTM C387/C387M - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar.
- J. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
- K. ASTM C476 - Standard Specification for Grout for Masonry.
- L. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
- M. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete.
- N. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry.
- O. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength.
- P. ASTM C1142 - Standard Specification for Extended Life Mortar for Unit Masonry.
- Q. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar.
- R. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
- S. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for 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.

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- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

#### **1.05 QUALITY ASSURANCE**

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

#### **1.06 PRECONSTRUCTION TESTING**

- A. Testing will be conducted by an independent test agency, in accordance with provisions of Section 01 4000 - Quality 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 ready-mixed mortar and grout, produced in off-site plant.
- B. Mortar Color: To match block. Submit full color range from manufacturer for Architect to select from.
- 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. Engineered Masonry: Type S.
  4. Exterior, Non-loadbearing Masonry: Type N.
  5. Min. Compressive Strength: 2000 psi for Buildings, typical. 2000 psi for site work.
- D. Grout Mix Designs:
1. Engineered Masonry: 2000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
    - a. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

#### **2.02 MATERIALS**

- A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C387/C387M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
1. Type: Types as scheduled in this section.
  2. Color: Mineral pigments added as required to produce approved color sample.
- B. Packaged Dry Material for Mortar for Repointing: Premixed Portland cement, hydrated lime, and graded sand; capable of producing Type O mortar in accordance with ASTM C270 with the addition of water only.
1. Color: Standard gray.

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- C. 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.
  - 1. Type: Coarse.
- D. Portland Cement: ASTM C150/C150M.
  - 1. Type: Type I - Normal; ASTM C150/C150M.
  - 2. Color: Color as required to produce approved color sample.
- E. Masonry Cement: ASTM C91/C91M.
  - 1. Type: Types as scheduled in this section; ASTM C91/C91M.
  - 2. Colored Mortar: Premixed cement as required to match Architect's color sample.
- F. Hydrated Lime: ASTM C207, Type S.
- G. Quicklime: ASTM C5, non-hydraulic type.
- H. Grout Aggregate: ASTM C404.
- I. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
  - 1. Color(s): As indicated on drawings.
- J. Water: Clean and potable.
- K. Bonding Agent: Latex type.
- L. Integral Water Repellent Admixture: Polymeric liquid admixture added to mortar at the time of manufacture.
  - 1. Performance of Mortar with Integral Water Repellent:
    - a. Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours:
      - 1) No water visible on back of wall above flashing at the end of 24 hours.
      - 2) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
      - 3) No more than 25 percent of wall area above flashing visibly damp at end of test.
    - b. Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
    - c. Compressive Strength: ASTM C1314; maximum 5 percent decrease.
    - d. Drying Shrinkage: ASTM C1148; maximum 5 percent increase in shrinkage.
  - 2. Use only in combination with masonry units produced with integral water repellent admixture.
  - 3. Manufacturers:
    - a. BASF; MasterPel 240MA (Formerly Rheopel Plus Mortar Admixture): [www.basf-admixtures.com](http://www.basf-admixtures.com).
    - b. ACM Chemistries Inc.: RainBloc Mortar Admixture: [www.acmchem.com](http://www.acmchem.com).
    - c. Substitutions: See Section 01 6000 - Product Requirements.

## 2.03 MORTAR MIXING

- A. Ready Mixed Mortar: ASTM C1142, Type equivalent to that specified according to ASTM C270.
- B. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
- C. Maintain sand uniformly damp immediately before the mixing process.
- D. 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.
- E. Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- F. Do not use anti-freeze compounds to lower the freezing point of mortar.

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- G. If water is lost by evaporation, re-temper only within two hours of mixing.

#### **2.04 PRECONSTRUCTION TESTING**

- A. Testing will be conducted by an independent test agency, in accordance with provisions of Section 01 4000 - Quality Requirements.

#### **2.05 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. Add admixtures in accordance with manufacturer's instructions; mix uniformly.  
 D. 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.

#### **3.02 INSTALLATION**

- A. Install mortar and grout to requirements of section(s) in which masonry is specified.  
 B. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.

#### **3.03 GROUTING**

- A. Perform all grouting by means of low-lift technique. Do not employ high-lift grouting.  
 B. Low-Lift Grouting:
  1. Limit height of pours to 12 inches.
  2. Limit height of masonry to 16 inches 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.

#### **3.04 FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field tests, in accordance with provisions of Section 01 4000 - Quality Requirements.  
 B. Test and evaluate mortar in accordance with ASTM C780 procedures.  
 C. Test and evaluate grout in accordance with ASTM C1019 procedures.

**END OF SECTION 04 0511**

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## SECTION 04 2900 ENGINEERED UNIT MASONRY

### PART 1 GENERAL

#### 1.01 RELATED REQUIREMENTS

- A. Section 03 2000 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
- B. Section 04 0511 - Mortar and Masonry Grout.
- C. Section 06 1000 - Rough Carpentry: Nailing strips built into masonry.
- D. Section 07 8400 - Firestopping: Firestopping at penetrations of masonry Work.

#### 1.02 REFERENCE STANDARDS

- A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; American Concrete Institute International; 2011.
- B. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.
- E. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- G. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
- H. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement.
- I. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- J. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2006b.
- K. ASTM C91/C91M - Standard Specification for Masonry Cement; 2005.
- L. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2007.
- M. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2004.
- N. ASTM C150/C150M - Standard Specification for Portland Cement; 2007.
- O. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
- P. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2007.
- Q. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
- R. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
- S. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete.
- T. ASTM C1019 - Standard Test Method for Sampling and Testing Grout; 2005.
- U. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength.
- V. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2007.
- W. ASTM E518/E518M - Standard Test Methods for Flexural Bond Strength of Masonry.

#### 1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting Work of this section.

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#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, and mortar and grout.
- C. Shop Drawings: Indicate bar sizes, spacings, reinforcement quantities, bending and cutting schedules, reinforcement supporting and spacing devices, and accessories.
- D. Samples: Submit four samples of decorative block units to illustrate color, texture, and extremes of color range.
- E. Design Data: Indicate required mortar strength, unit assembly strength in each plane, and supporting test data.
- F. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

#### **1.05 QUALITY ASSURANCE**

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
  - 1. Masonry unit manufacturer shall be certified to produce concrete masonry units with integral water-repellents specified.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- C. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.
- D. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of the Contract documents.

#### **1.06 MOCK-UP**

- A. Construct a masonry wall as a mock-up panel sized 8 feet long by 6 feet high; include mortar and accessories, structural backup, reinforcement, grout, flashings, weather barrier, and wall insulation in mock-up.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

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

#### **1.08 FIELD CONDITIONS**

- A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry Work.
- B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry Work.

### **PART 2 PRODUCTS**

#### **2.01 CONCRETE MASONRY UNITS**

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, pilasters, jambs, sashes, movement joints, headers, bonding, caps and other special conditions.

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- a. Provide deep-cut bond beam blocks to allow horizontal reinforcing to pass through without modification of the block or coursing.
    - b. Provide bond-beam units at all locations with horizontal steel reinforcing bars to provide minimum vertical opening of 3-inches by 3-inches at all crosswebs.
  2. Provide square-edged for outside corners unless otherwise indicated.
- B. Concrete Masonry Units: ASTM C 90, two-core type, modular sizes as indicated.
  1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength as indicated on drawings.
  2. Density Classification:
    - a. Medium weight unless otherwise indicated.
  3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
  4. Admixture: Add water repellant admixture to block mix in accordance of requirements of the manufacturer:
    - a. All concrete block units.
    - b. Test units with integral water-repellent admixtures after bead-blasting.
    - c. Water repellant admixture by one of the following:
      - 1) Dry-Block, as manufactured by Grace Construction Products
      - 2) Rheomix 235 polymeric integral water repellant admixture system as manufactured by Master Builders.
      - 3) RainBloc, an integral liquid water-repellent admixture as manufactured by ACM Chemistries, Inc.
- C. Manufacturer: Basis of Design products are manufactured by Basalite Concrete Products, LLC.
  1. Or approved equivalent product by:
    - a. Orco Block Company, Inc.
    - b. Angelus Block Company, Inc.
    - c. Air Vol Block, Inc.
  2. Surface Texture:
    - a. Provide indicated surface on one, both, and end faces (4 faces), as required.
    - b. Visually Concealed Masonry: Precision.
    - c. Visually Exposed Masonry: **As indicated on the drawings.**
  3. Face Pattern: **As indicated on the drawings.**
  4. Color:
    - a. Provide on one, both, and end faces (4 faces), as required.
    - b. Field: **As indicated on the drawings.**
    - c. Accent: **As indicated on the drawings.**
    - d. Visually Concealed Masonry: Gray.
- D. Concrete Block: Comply with referenced standards and as follows:
  1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depth of 8 inches.
  2. Special Shapes: Provide non-standard blocks configured for corners, lintels, and headers. Closed bottom at header units.

## 2.02 LINTELS

- A. General: Provide one of the following:
- B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.
- C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Division 03 Section "Cast-in-Place Concrete" and with reinforcing bars indicated.

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- D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

### 2.03 MORTAR AND GROUT MATERIALS

- A. Regional Materials: Provide aggregate for mortar and grout, and cements that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Projects site.
- B. Portland Cement: ASTM C 150, Type I or II. Provide natural color or white cement as required to produce mortar color indicated.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime containing no other ingredients. Portland cement and lime shall comply with the requirements above.
- E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, color stable, free of carbon black, nonfading, resistant to lime and other alkalis, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Davis Colors; True Tone Mortar Colors.
    - b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
    - c. Solomon Colors, Inc.; SGS Mortar Colors.
- F. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
  3. White-Mortar Aggregates: Natural white sand or crushed white stone.
  4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- G. Aggregate for Grout: ASTM C 404.
1. Grout Coarse Aggregate: Maximum 3/8-inch size.
  2. Grout Fine Aggregate: Washed river sand.
- H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Euclid Chemical Company (The); Accelguard 80.
    - b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
    - c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.
- I. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs, containing integral water repellent by same manufacturer.
1. Products: Subject to compliance with requirements, provide one of the following. The product furnished shall be the same product used by the CMU manufacturer:
    - a. Basis of Design: ACM Chemistries, Inc.; RainBloc for Mortar.
    - b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
    - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
  2. Water: Potable.
- J. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.

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- K. Hydrated Lime: ASTM C207, Type S.
- L. Mortar Aggregate: ASTM C144.
- M. Grout Aggregate: ASTM C404.
- N. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
  - 1. Color(s): As selected by Architect from manufacturer's full range.
  - 2. Manufacturers:
    - a. Davis Colors: [www.daviscolors.com](http://www.daviscolors.com).
    - b. Lambert Corporation: [www.lambertusa.com/#sle](http://www.lambertusa.com/#sle).
    - c. Solomon Colors, Inc.: [www.solomoncolors.com/#sle](http://www.solomoncolors.com/#sle).

#### **2.04 REINFORCEMENT AND ANCHORAGE**

- A. Reinforcing Steel: Type specified in Section 03 2000; size as indicated on drawings; galvanized finish.

#### **2.05 MISCELLANEOUS MASONRY ACCESSORIES**

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.
- B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- C. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
    - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
    - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
    - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.
- D. Masonry Cleaner:
  - 1. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
    - a. Manufacturer: Basis of Design: Provide products by the following, or accepted substituted products:
      - 1) ProSoCo, Inc.

#### **2.06 MORTAR AND GROUT MIXES**

- A. General: Comply with requirements of CBC and ASTM C476. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  - 1. Do not use calcium chloride in mortar or grout.
  - 2. Use Portland cement-lime mortar unless otherwise indicated.
  - 3. If indicated to be used, provide cold-weather admixture at same rate for all mortar that will be exposed to view, regardless of weather conditions or location, to ensure that mortar color is consistent.
- B. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a pre-blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Projects site.

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- C. Mortar for Reinforced Unit Masonry: Provide Type S mortar for all applications unless another type is needed to provide required compressive strength of masonry. Comply with the following:
1. Comply with CBC section 2103.9, Proportion Specification.
  2. Mortar compressive strength shall be as required to attain the compressive strength (f'm) indicated on drawings.
  3. Place approximately half of the required water and sand in the mixer while running.
  4. Add the cement and the remainder of the sand and water into the mixer, in that order, and mix for at least two minutes.
  5. Add the lime and continue mixing as long as needed to secure a uniform mass.
  6. Add integral water-repellent admixture and pigment color in compliance with manufacturer's instructions and recommendations.
  7. The total mixing time shall not be less than ten minutes.
- D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
1. Pigments shall not exceed 10 percent of portland cement by weight.
  2. Pigments shall not exceed 5 percent of mortar cement by weight.
  3. Mix to match Architect's sample.
  4. Application: Use pigmented mortar for exposed mortar joints with the following units:
    - a. Decorative CMUs.
    - b. Pre-faced CMUs.
    - c. Concrete facing brick.
    - d. Cast stone trim units.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
1. Insert materials and proportions used for sample in first subparagraph below if known.
  2. Mix to match Architect's sample.
  3. Application: Use colored aggregate mortar for exposed mortar joints with the following units:
    - a. Decorative CMUs.
    - b. Pre-faced CMUs.
    - c. Concrete facing brick
    - d. Cast stone trim units.
- F. Grout for Unit Masonry: Comply with ASTM C 476 and the following:
1. CBC section 2106.13, Proportion Specification.
  2. Grout compressive strength shall not be as indicated on drawings, and shall not be less than 2000 psi.
  3. Use coarse grout that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
  4. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.
  5. Shovel measures shall not be allowed.
  6. Grout shall be high-slump Workable mix, preferably placed by pumping to permit continuous pouring.
  7. Grout shall be Worked into all voids. Mechanical vibrators shall be used for consolidation. Where job conditions preclude such use, propose and submit other methods for Architect's review prior to use.
  8. Grout shall be reconsolidated after it has taken on a plastic consistency but prior to its initial set, because of the high water/cement content. Reconsolidate grout to overcome settlement shrinkage and separation from reinforcing steel and to promote bond to CMU.

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9. Sufficient water may be added to make a Workable mix that will flow into voids of masonry without separation or segregation. When grout is placed in walls with typical rates of absorption, grout slump shall be approximately nine to ten inches depending on temperature and humidity.
10. Where the least lateral dimension of cells to be filled exceeds five inches, larger aggregate may be used in grout. Such grout mix shall comply with the specified requirements for cast-in-place concrete, ACI 318 Section 5 and the following:
  - a. The maximum size of aggregate shall not exceed one inch.
  - b. Subject to Architect's review, the water/cement ratio per sack of cement may exceed that specified by reference standard or indicated to allow for absorption by masonry units and to provide sufficient Workability to meet installation requirements.
  - c. Large-aggregate grout shall be subject to all required preconstruction and field tests.

## **2.07 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. Add mortar color in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.
- D. Do not use anti-freeze compounds to lower the freezing point of mortar.
- E. If water is lost by evaporation, re-temper only within two hours of mixing.

## **2.08 GROUT MIXING**

- A. Mix grout in accordance with ASTM C94/C94M.
- B. Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- C. Do not use anti-freeze compounds to lower the freezing point of grout.

## **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. Clean reinforcement of loose rust.
- C. For areas where high-lift grouting will be employed, provide cleanout openings as follows:
  1. Brick Masonry: Not less than 8 inches on center at the bottom of one wythe, formed by omitting bricks.

### **3.03 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. Mortar Joints: Concave.

### **3.04 PLACING AND BONDING**

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other Work.

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### 3.05 REINFORCEMENT AND ANCHORAGE

- A. Reinforcement Bars: Secure at locations indicated and to avoid displacement during grouting. Minimum spacing between bars or to masonry surfaces shall be one bar diameter.
  - 1. Welding of splices is not permitted.

### 3.06 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 12 inches.
  - 2. Limit height of masonry to 16 inches 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. Clean out masonry cells and other cavities to be grouted by high pressure water spray or compressed air. Remove debris, allow to dry, and inspect before sealing cleanout openings.
  - 3. Hollow Masonry: Limit lifts to maximum 4 feet and pours to maximum height of 12 feet.
  - 4. Place grout for spanning elements in single, continuous pour.
  - 5. To reduce the possibility of "blow-outs," do not pour grout until the mortar has adequately cured. Grout the walls as soon as possible after mortar has cured to reduce shrinkage and cracking of the vertical joints.
- D. Grout Spacing requirements
  - 1. The minimum dimensions of spaces provided for the placement of grout shall be per ACI 530-11 1.20.1

### 3.07 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Form expansion joint as detailed on drawings.

### 3.08 BUILT-IN WORK

- A. As Work progresses, install built-in metal door 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.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

### 3.09 TOLERANCES

- A. Maximum Variation from Alignment of Columns: 1/4 inch.
- B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

### 3.10 CUTTING AND FITTING

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- A. Cut and fit for chases. Coordinate with other sections of Work to provide correct size, shape, and location.

### **3.11 FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. Mortar Tests: Test each type of mortar in accordance with recommended procedures in ASTM C780, testing with same frequency as masonry samples.
- C. Test and evaluate grout in accordance with ASTM C1019 procedures.
  - 1. Test with same frequency as specified for masonry units.
- D. Prism Tests: Per CBC section 2105.2.2.2. 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; perform tests and evaluate results.

### **3.12 CLEANING**

- A. Remove excess mortar and mortar smears as Work progresses.
- B. Replace defective mortar. Match adjacent Work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.
- E. Within 4 to 6 days after all masonry Work is completed, clean all visually exposed walls as follows:
  - 1. Pre-wet the wall evenly with a hose using clean water.
  - 2. Scrub / apply cleaning agent with non-metallic brush.
  - 3. Rinse cleaning agent while still wet with a hose using clean water.

### **3.13 PROTECTION**

- A. Without damaging completed Work, provide protective boards at exposed external corners that are subject to damage by construction activities.
- B. Protect top of unit masonry to avoid water infiltration into the cells during a rain event.

**END OF SECTION 04 2900**

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## SECTION 05 1200 STRUCTURAL STEEL FRAMING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Structural steel framing members.
- B. Grouting under base plates.

#### 1.02 RELATED REQUIREMENTS

- A. Section 05 1213 - Architecturally-Exposed Structural Steel Framing: Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS).
- B. Section 05 3100 - Steel Decking: Support framing for small openings in deck.
- C. Section 05 5000 - Metal Fabrications: Steel fabrications affecting structural steel work.

#### 1.03 REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual.
- B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
- F. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
- G. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- H. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
- I. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric).
- J. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
- K. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.
- 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.
- M. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
- N. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- O. AWS D1.1/D1.1M - Structural Welding Code - Steel.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
- C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
- D. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.

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## 1.05 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. Steel Angles and Plates: ASTM A36/A36M.
- B. Steel W Shapes and Tees: ASTM A992/A992M.
- C. Steel Plates and Bars: ASTM A572/A572M, Grade 50 (345) high-strength, columbium-vanadium steel.
- D. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.
- E. Pipe: ASTM A53/A53M, Grade B, Finish black.
- F. 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.
- G. Unheaded Anchor Rods: ASTM F1554, Grade 36, plain, with matching ASTM A563 or ASTM A563M nuts and ASTM F436/F436M Type 1 washers.
- H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- I. 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.

## PART 3 EXECUTION

### 3.01 ERECTION

- A. Erect structural steel in compliance with AISC 303.

**END OF SECTION 05 1200**

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## SECTION 05 1213 ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL FRAMING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS).

#### 1.02 RELATED REQUIREMENTS

- A. Section 05 1200 - Structural Steel Framing: General requirements for structural steel members, including AESS framing specified in this section.
- B. Section 05 3100 - Steel Decking: Erection requirements relating to exposed steel decking and its connections.
- C. Section 05 5000 - Metal Fabrications: Loose steel bearing plates and miscellaneous steel framing.
- D. Section 09 9113 - Exterior Painting: Finish coat requirements and coordination with primer and surface preparation specified in this section.
- E. Section 09 9123 - Interior Painting: Finish coat requirements and coordination with primer and surface preparation specified in this section.
- F. Section 09 9600 - High-Performance Coatings: Finish coat requirements and coordination with primer and surface preparation specified in this section.

#### 1.03 REFERENCE STANDARDS

- A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges.
- B. AISC 360 - Specification for Structural Steel Buildings.
- C. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- F. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- G. ASTM A1085/A1085M - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
- H. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Detailing for fabrication of AESS components.
  - 1. Provide erection documents clearly indicating which members are AESS members and the AESS category of each part.
  - 2. Include details that clearly identify AESS requirements found in this specification. Provide connections for AESS consistent with concepts shown on drawings.
  - 3. Indicate welds by AWS A2.4 symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds as defined by the designated AESS category.

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- C. AESS 1, AESS 2, AESS 3, AESS 4, and AESS C Samples: Provide samples of specific AESS characteristics. Samples may be small size samples or components of conventional structural steel demonstrating specific AESS characteristics, including surface preparation, sharp edges ground smooth, continuous weld appearance, weld show through, and fabrication mark removal.

#### **1.05 QUALITY ASSURANCE**

- A. Erector Qualifications: In addition to those qualifications listed in Section 05 1200, engage an AISC Certified Erector, experienced in erecting AESS work similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance.

#### **1.06 MOCK-UP**

- A. Locate mock-ups on site. Mock-ups to be full-size unless Architect approves smaller models. Alternatively, when a mock-up is not practical, the first piece of an element or connection can be used to determine acceptability.
- B. Build mock-ups using member sizes and materials indicated for final work.
- C. Mock-up to demonstrate weld quality, contouring of welds at aligned walls of members, specified surface preparation, and finish coating.
- D. Approved mock-ups in an undisturbed condition at Date of Substantial Completion may become part of completed work.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. Use special care in handling to prevent twisting or warping of AESS members.

### **PART 2 PRODUCTS**

#### **2.01 GENERAL REQUIREMENTS**

- A. Comply with Section 05 1200, except as amended in this section for aesthetic purposes.

#### **2.02 FABRICATION**

- A. Fabricate and assemble AESS in shop to greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by Architect. Detail AESS assemblies to minimize field handling and expedite erection.
- B. Permissible tolerances for member depth, width, out of square, and camber and sweep to be as specified in ASTM A6/A6M, ASTM A500/A500M, and ASTM A1085/A1085M.
- C. Use special care in handling and shipping of AESS both before and after shop painting to minimize damage to any shop finish. Use nylon-type slings or softeners when using chains or wire rope slings.
- D. Fabricate AESS in accordance with categories defined in AISC 303, as follows:
  - 1. AESS 1: Basic elements.
  - 2. AESS 2: Feature elements viewed at a distance greater than 20 feet (feature elements not in close view).

#### **2.03 SHOP PRIMING**

- A. Surface Preparation:
  - 1. Coordinate required surface profile with approved paint submittal prior to beginning surface preparation.

#### **2.04 GALVANIZING**

- A. Hot-Dip Galvanized Finish: Apply zinc coating by hot-dip process to AESS indicated for galvanizing according to ASTM A123/A123M. Fabricate such that all connections of assemblies are made in the field with bolted connections where possible.

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## **2.05 SOURCE QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. AESS 1 and 2 Acceptance: Architect to observe AESS in the shop at a viewing distance consistent with final installation and determine acceptability based on qualification data and submittals. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

## **PART 3 EXECUTION**

### **3.01 ERECTION**

- A. AESS 1 and 2: Basic elements; feature elements not in close view:
  - 1. Employ special care to handle and erect AESS. Erect finished pieces using nylon straps or chains with softeners such that they are not damaged.
  - 2. Place weld tabs for temporary bracing and safety cabling at points concealed from view in completed structure or where approved by Architect during pre-installation meeting. Obtain Architect approval of methods for removing temporary devices and finishing AESS members prior to erection.
  - 3. AESS Erection Tolerances: Erect to standard frame tolerances for structural steel per Chapter 7 of AISC 303.
  - 4. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
  - 5. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
  - 6. Remove all backing and run out tabs.
  - 7. When temporary braces or fixtures are required to facilitate erection, take care to avoid any blemishes, holes or unsightly surfaces resulting from use or removal of such temporary elements.

### **3.02 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. AESS 1 and 2 Acceptance: Architect to observe AESS in place and determine acceptability based on qualification data and submittals. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

### **3.03 CLEANING**

- A. Touch-up Painting: Complete cleaning and touch-up painting of field welds, bolted connections, and abraded areas of shop paint to blend with adjacent surfaces of AESS. Perform touch-up work in accordance with manufacturer's instructions and as specified in Section 09 9113, 09 9123, and 09 9600.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas. Repair galvanized surfaces in accordance with ASTM A780/A780M.

**END OF SECTION 05 1213**

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## SECTION 05 3100 STEEL DECKING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Roof deck.
- B. Supplementary framing for openings up to and including 18 inches.
- C. Bearing plates and angles.

#### 1.02 RELATED REQUIREMENTS

- A. Section 04 2000 - Unit Masonry: Placement of anchors for bearing plates embedded in unit masonry assemblies.
- B. Section 05 1200 - Structural Steel Framing: Support framing for openings larger than 18 inches and shear stud connectors.
- C. Section 05 1200 - Structural Steel Framing: Placement of embedded steel anchors for bearing plates in cast-in-place concrete.

#### 1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- D. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel.
- E. ICC-ES AC43 - Acceptance Criteria for Steel Deck Roof and Floor Systems.
- F. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittals 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.

#### 1.05 QUALITY ASSURANCE

- A. Design deck layout, spans, fastening, and joints 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.

### PART 2 PRODUCTS

#### 2.01 STEEL DECK

- A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.
  - 1. Calculate to structural working stress design and structural properties specified.
- B. Roof Deck: Non-composite type, fluted steel sheet:
  - 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.

#### 2.02 ACCESSORY MATERIALS

- A. Bearing Plates and Angles: ASTM A36/A36M steel, galvanized per ASTM A123/A123M.
- B. Welding Materials: AWS D1.1/D1.1M.

### PART 3 EXECUTION

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### **3.01 EXAMINATION**

- A. Verify existing conditions prior to beginning work.

### **3.02 INSTALLATION**

- A. Erect metal deck in accordance with the California Building Code, the Drawings, and as noted above. Align and level.
- B. On concrete and masonry surfaces provide minimum 4 inch bearing.
- C. On steel supports provide minimum 2 inch end bearing and 4 inch interior bearing.
- D. Weld deck in accordance with AWS D1.3/D1.3M.
- E. At deck openings from 6 inches to 24 inches in size, see drawings for reinforcement.
- F. At deck openings greater than 24 inches in size, see drawings for reinforcement.
- G. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

**END OF SECTION 05 3100**

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## SECTION 05 4000 COLD-FORMED METAL FRAMING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Formed steel stud exterior wall and interior wall framing.

#### 1.02 RELATED REQUIREMENTS

- A. Section 05 3100 - Steel Decking.
- B. Section 09 2116 - Gypsum Board Assemblies: Gypsum-based sheathing.

#### 1.03 REFERENCE STANDARDS

- A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- D. 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.
- E. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
- F. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- G. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel.
- H. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.
- C. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention .

#### 1.06 QUALITY ASSURANCE

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

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Metal Framing:
  - 1. Member of Steel Framing Industry Association (SFIA) complying with ICC-ESR 4205.
  - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Framing Connectors and Accessories:
  - 1. Same manufacturer as metal framing.

#### 2.02 FRAMING SYSTEM

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- A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

### **2.03 FRAMING MATERIALS**

- A. Studs and Track: ASTM C955; studs formed to channel, "C", or "Sigma" shape with punched web; U-shaped track in matching nominal width and compatible height.
  - 1. Gage and Depth: As indicated on drawings.
- B. Framing Connectors: Factory-made, formed steel sheet.
  - 1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gage, 0.1345 inch, and factory punched holes and slots.
  - 2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
  - 3. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.

### **2.04 FASTENERS**

- A. Self-Drilling, Self-Tapping Screws per ASTM C1513, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
- B. Anchorage Devices: Powder actuated, Drilled expansion bolts, and as specified in the drawings.
- C. Welding: Comply with AWS D1.1/D1.1M.

### **2.05 WALL SHEATHING**

- A. Gypsum Board Wall Sheathing: See Section 09 2116.

### **2.06 ACCESSORIES**

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
- B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
- C. Water-Resistive Barrier: As specified in Section 07 2500.

## **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 INSTALLATION OF STUDS**

- A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.

### **3.03 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. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.

**END OF SECTION 05 4000**

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## SECTION 05 5000 METAL FABRICATIONS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Prefabricated ladders and ship ladders.

#### 1.02 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- D. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

### PART 2 PRODUCTS

#### 2.01 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209 (ASTM B209M), 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Bars: ASTM B211 (ASTM B211M), 6061 alloy, T6 temper.
- D. Bolts, Nuts, and Washers: Stainless steel.

#### 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 B221 ASTM B221M 6063 alloy, T52 temper.
  - 3. Finish: Manufacturer's standard clear anodized coating, comply with AAMA 611, Class 1.
  - 4. Manufacturers:
    - a. O'Keeffe's Inc; Model 500: [www.okeeffes.com/#sle](http://www.okeeffes.com/#sle).
    - b. Substitutions: See Section 01 6000 - Product Requirements.

#### 2.04 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.

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- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.

#### **3.02 INSTALLATION**

- A. Install items plumb and level, accurately fitted, free from distortion or defects.

#### **3.03 TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

**END OF SECTION 05 5000**

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## SECTION 06 4100 ARCHITECTURAL WOOD CASEWORK

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Countertops.
- B. Hardware.

#### 1.02 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.

#### 1.03 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

#### 1.04 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 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.

#### 2.02 COUNTERTOPS

- A. Plastic Laminate Countertops: Medium density fiberboard substrate covered with HPDL, conventionally fabricated and self-edge banded.

#### 2.03 HARDWARE

- A. Countertop Supports:
  - 1. Material: Aluminum
  - 2. Finish/Color: Clear anodized.

#### 2.04 FABRICATION

- A. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.

#### 3.02 INSTALLATION

- A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

#### 3.03 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

**END OF SECTION 06 4100**

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## SECTION 06 8316 FIBERGLASS REINFORCED PANELING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Fiberglass reinforced plastic panels.
- B. Trim.

#### 1.02 REFERENCE STANDARDS

- A. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Fiberglass Reinforced Plastic Panels:
  - 1. Crane Composites, Inc: [www.cranecomposites.com/#sle](http://www.cranecomposites.com/#sle).
  - 2. Marlite, Inc: [www.marlite.com/#sle](http://www.marlite.com/#sle).
  - 3. Nudo Products, Inc: [www.nudo.com/#sle](http://www.nudo.com/#sle).

#### 2.02 PANEL SYSTEMS

- A. Wall Panels:
  - 1. Panel Size: 4 by 8 feet.
  - 2. Surface Design: Embossed.
  - 3. Color: White.
  - 4. Attachment Method: Adhesive only, sealant joints, no trim.

#### 2.03 MATERIALS

- A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
  - 1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
- B. Trim: Vinyl; color coordinating with panel.
- C. Sealant: Type recommended by panel manufacturer; white.

### 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 - WALLS

- A. Install panels in accordance with manufacturer's instructions.
- B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.
- C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.

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- D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
- E. Install panels with manufacturer's recommended gap for panel field and corner joints.
- F. Place trim on panel before fastening edges, as required.
- G. Fill channels in trim with sealant before attaching to panel.
- H. Install trim with adhesive and screws or nails, as required.
- I. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.
- J. Remove excess sealant after paneling is installed and prior to curing.

**END OF SECTION 06 8316**

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## SECTION 07 1400 FLUID-APPLIED WATERPROOFING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Fluid-Applied Waterproofing:
  - 1. Cold-applied modified-polymer elastomeric waterproofing.

#### 1.02 REFERENCE STANDARDS

- A. NRCA (WM) - The NRCA Waterproofing Manual.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for membrane and joint and crack sealants.

#### 1.04 FIELD CONDITIONS

#### 1.05 WARRANTY

- A. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no cost to Owner.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

#### 2.02 FLUID APPLIED WATERPROOFING MATERIALS

- A. Cold-Applied Modified-Polymer Elastomeric Waterproofing:
  - 1. Cured Thickness: 55 mils, 0.055 inch, minimum.
  - 2. Suitable for installation over concrete substrates.
  - 3. Products:
    - a. Carlisle Coatings & Waterproofing, Inc; MiraSEAL: [www.carlisleccw.com/#sle](http://www.carlisleccw.com/#sle).
    - b. Henry Company; Henry CM100: [www.henry.com/#sle](http://www.henry.com/#sle).
    - c. W.R. Meadows, Inc; HYDRALASTIC 836: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).

#### 2.03 ACCESSORIES

- A. Sealant for Joints and Cracks in Substrate: Type compatible with waterproofing material and as recommended by waterproofing manufacturer.
- B. Protection Board: Provide type capable of preventing damage to waterproofing due to backfilling and construction traffic.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.
- C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.

#### 3.02 PREPARATION

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.
- C. Do not apply waterproofing to surfaces unacceptable to waterproofing manufacturer.
- D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.

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- E. Seal moving cracks with sealant and non-rigid filler, using procedures recommended by sealant and waterproofing manufacturers.
- F. Install cant strips at inside corners.

### **3.03 INSTALLATION**

- A. Install waterproofing to specified minimum thickness in accordance with manufacturers instructions and NRCA (WM) applicable requirements.
- B. Seal membrane and flashings to adjoining surfaces.

### **3.04 INSTALLATION - PROTECTION BOARD**

- A. Place protection board directly against cured membrane; butt joints, and scribe and cut boards around projections, penetrations, and interruptions.

### **3.05 PROTECTION**

- A. Do not permit traffic over unprotected or uncovered membrane.

**END OF SECTION 07 1400**

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## SECTION 07 2100 THERMAL INSULATION

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Board insulation at over roof deck.
- B. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

#### 1.02 REFERENCE STANDARDS

- A. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

### PART 2 PRODUCTS

#### 2.01 APPLICATIONS

#### 2.02 BATT INSULATION MATERIALS

- A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
  - 1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
  - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
  - 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
  - 4. Formaldehyde Content: Zero.
  - 5. Facing: Aluminum foil, one side.
  - 6. Products:
    - a. CertainTeed Corporation: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
    - b. Johns Manville: [www.jm.com/#sle](http://www.jm.com/#sle).
    - c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).

#### 2.03 ACCESSORIES

- A. Insulation Fasteners: Appropriate for purpose intended and approved by Factory Mutual and roofing manufacturer.
  - 1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.

### 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.

#### 3.02 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.

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2. Fasten insulation to deck in accordance with roofing manufacturer's written instructions and applicable Factory Mutual requirements.
3. Do not apply more insulation than can be covered with roofing on the same day.

### **3.03 BATT INSTALLATION**

- A. Install insulation in accordance with manufacturer's instructions.
- B. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- C. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- D. Install with factory-applied vapor retarder membrane facing warm side of building spaces. Lap ends and side flanges of membrane between framing members.
- E. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

### **3.04 PROTECTION**

- A. Do not permit installed insulation to be damaged prior to its concealment.

**END OF SECTION 07 2100**

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## SECTION 075419 - POLYVINYL-CHLORIDE (PVC/TPA) ROOFING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  1. Mechanically-fastened thermoplastic PVC/TPA roofing system on wood or metal deck, including:
  2. Roof insulation.
  3. Roof insulation cover board.
  4. Walkway material.

#### 1.3 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. SDS: For each type of product indicated.
- C. Samples for Verification: For the following products:
  1. Sheet roofing, of color specified.
  2. Roof insulation.
  3. Walkway pads or rolls.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Contractor's Approval Certificate.
  1. Include letter from Manufacturer written for this Project indicating approval of Installer.
- B. Qualification Data: For Roofing Inspector.

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1. Include a notarized letter from a corporate officer of the manufacturer stating that a manufacturer-employed inspector will provide three days per week jobsite inspections for the duration of the project.
2. Provide three sample job site inspection reports used on previous projects.
3. Provide five references of projects where three days per week jobsite inspections were performed by the manufacturer. Include customer name, point of contact, phone number and email address.

C. Warranties: Unexecuted sample copies of special warranties.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: To include in maintenance manuals.
- B. Warranties: Manufacturer and contractor warranties.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and certified by manufacturer, including a full-time on-site supervisor with a minimum of five years' experience installing products comparable to those specified, able to communicate verbally with Contractor, Architect, and employees, and qualified by the manufacturer to install manufacturer's product and furnish warranty of type specified.
- B. Manufacturer Qualifications: Approved manufacturer listed in this Section, UL listed for roofing systems identical to that specified for this Project, with minimum five years' experience in manufacture of specified products in successful use in similar applications.
- C. Roofing Inspector Qualifications: A technical representative of manufacturer not engaged in the sale of products and experienced in the installation and maintenance of the specified roofing system, qualified to perform roofing observation and inspection specified in Field Quality Control Article, to determine Installer's compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification. The Roofing Inspector shall be one of the following:
  1. An authorized full-time technical employee of the manufacturer.
- D. Preinstallation Roofing Conference: Conduct conference at Project site.
  1. Meet with Owner, Architect, roofing Installer, roofing system manufacturer's representative, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
  2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
  3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

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4. Examine substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
  1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

#### 1.9 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
- B. Daily Protection: Coordinate installation of roofing so insulation and other components of roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
  1. Provide tie-offs at end of each day's work to cover exposed roofing and insulation with a course of roofing sheet securely in place with joints and edges sealed.

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2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing.
3. Remove temporary plugs from roof drains at end of each day.
4. Remove and discard temporary seals before beginning work on adjoining roofing.

#### 1.10 WARRANTY

- A. Warranty, General: Warranties specified shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
- B. Manufacturer's Warranty: Manufacturer's standard or customized form, in which manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
  1. Manufacturer's warranty includes roofing membrane, base flashings, fasteners, roofing membrane accessories and other components of roofing system specified in this Section.
  2. Warranty documents that exclude components not supplied by the manufacturer are not acceptable to the Owner.
  3. Warranty document will not exclude damaged from windspeeds below 74 MPH.
  4. Warranty Period: 20 years from date of Substantial Completion.
- C. Installer's Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section and related Sections indicated above, including all components of membrane roofing such as single ply roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:
  1. Warranty Period: Two years from date of Substantial Completion.
- D. Manufacturer Inspection Services: By manufacturer's technical representative, to report maintenance responsibilities to Owner necessary for preservation of Owner's warranty rights. The cost of manufacturer's inspections is included in the Contract Sum.
  1. Inspections to occur in following years: 2, 5, 10, 15 following completion.
  2. Inspections include rooftop housekeeping, including removal of incidental debris (such as leaves, branches, paper and similar items) from the roof membrane and drainage areas such as gutters. All debris will be disposed of at the Owner's approved on-site location.

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## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by a manufacturer meeting qualification requirements in Quality Assurance Article.
- B. Basis-of-Design Manufacturer/Product: The roof system specified in this Section is based upon products of Tremco, Inc. or Owner Approved Equal.
- C. Source Limitations: Obtain components for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures noted on drawings per FL16425-R4 evaluation report system no. SC-48 (-45 psf max. design pressure), thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
  - 1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
  - 2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- D. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.
- E. Energy Performance: Roofing system shall have an initial solar reflectance index of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

### 2.3 THERMOPLASTIC MEMBRANE MATERIALS

- A. Thermoplastic PVC/TPA sheet, ASTM D4434 Type IV internally fabric reinforced, Energy Star qualified, CRRC listed, and California Title 24 Energy Code compliant. The PVC/TPA sheet is comprised of an elastomeric tri-polymer alloy that is a blend of CPE, Elvaloy, and PVC.
  - 1. Basis of design product: Tremco, TPA Roof Membrane or Equal.
  - 2. Tensile Strength at 0 deg. F (-18 deg. C), minimum, ASTM D 751: 300 lbf/in.

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3. Tear Strength at 77 deg. F (25 deg. C), minimum, ASTM D 751: 100 lbf.
4. Elongation at 0 deg. F (-18 deg. C), minimum at fabric break, ASTM D 751: 25 percent.
5. Minimum Thickness, nominal, ASTM D 751: 60 mils.
6. Exposed Face Color: White.
7. Reflectance, ASTM C 1549: 86 percent.
8. Thermal Emittance, ASTM C 1371: 0.86.
9. Solar Reflectance Index (SRI), ASTM E 1980: 108.
10. Recycled Content, minimum: 25 percent preconsumer.

- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC/TPA sheet membrane.

## 2.4 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Membrane Bonding Adhesive:
1. Elastomeric solvent-based contact-type adhesive for bonding TPA single ply membranes and flashings to substrates.
    - a. TPA LV Single Ply Bonding Adhesive or Equal.
    - b. Density at 77 deg. F (25 deg. C), minimum, ASTM D 1475: 7.0 lb/gal.
    - c. Percent solids, minimum: 25 percent.
- C. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 mm by 3 mm) thick; with anchors.
- D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to membrane roofing system manufacturer.
- E. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

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- F. Insulation Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

## 2.5 ROOF INSULATION MATERIALS

- A. General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from insulation manufacturer's standard sizes, suitable for application, and of thicknesses indicated.
- B. Roof Insulation: Provide roof insulation product in thicknesses indicated in Part 3 as follows:
  - 1. Board Insulation, Polyisocyanurate: CFC- and HCFC- free, with recycled content glass-fiber mat facer on both major surfaces, ASTM C1289 Type II Class 1.
  - 2. Thickness: As shown in drawings.

## 2.6 COVER BOARD

- A. Cover Board:
  - 1. Gypsum panel, glass-mat-faced, ASTM C1177/C1177M.
    - a. Basis of design product: Tremco/GP Gypsum DensDeck or equivalent.
    - b. Thickness: 1/4 inch (6 mm).

## 2.7 WALKWAY MATERIALS

- A. Walkway roll, reinforced PVC/TPA membrane roll with serrated slip-resistant surface, fabricated for heat welding to compatible PVC/TPA membrane surface.
  - 1. TPA Walkway Roll or Equal.
  - 2. Roll Size: 36 inches by 60 feet.
  - 3. Thickness: 0.080 inch.
  - 4. Color: Grey.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
  - 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.

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2. Wood Roof Deck: Verify that wood deck is securely fastened with no projecting fasteners.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

### 3.3 INSTALLATION, GENERAL

- A. Install roofing system in accordance with manufacturer's recommendations.

### 3.4 INSULATION INSTALLATION

- A. Cover Boards: Install cover boards straight lines with end joints staggered between rows. Loosely butt cover boards together and mechanically fasten to roof deck.
  1. Mechanically fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.
  2. Mechanically fasten cover boards using #12 screws with 3" insulation plates to deck , minimum 8 fasteners per 4' x 8' board.

### 3.5 MECHANICALLY FASTENED MEMBRANE ROOFING INSTALLATION

- A. Mechanically fasten membrane roofing over area to receive roofing and install according to roofing system manufacturer's written instructions.
  1. Install sheet according to ASTM D 5082.
- B. Start installation of membrane roofing in presence of roofing system manufacturer's technical personnel.
- C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Mechanically fasten or adhere membrane roofing securely at terminations, penetrations, and perimeter of roofing.
- E. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

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- F. Welded Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
  - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
  - 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
  - 3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
- G. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

### 3.6 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

### 3.7 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.
- B. Walkways will not be installed over seams in single ply membrane.

### 3.8 FIELD QUALITY CONTROL

- A. Manufacturer Inspector: Manufacturer will employ technical personnel to inspect the roof while it is being installed. Roof will be inspected a minimum of 3 times per week while in progress with jobsite reports, including photos, sent to all of the project stakeholders.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

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- D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.9 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

END OF SECTION

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**SECTION 07 6200**  
**SHEET METAL FLASHING AND TRIM**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

**1.02 REFERENCE STANDARDS**

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

**PART 2 PRODUCTS**

**2.01 SHEET MATERIALS**

**END OF SECTION 07 6200**

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## SECTION 07 7100 ROOF SPECIALTIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Manufactured roof specialties, including copings and fascias.

#### 1.02 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- B. NRCA (RM) - The NRCA Roofing Manual.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for 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. Samples: Submit two appropriately sized samples of coping.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Roof Edge Flashings and Copings:
  1. Architectural Products Co: [www.archprod.com/#sle](http://www.archprod.com/#sle).
  2. ATAS International, Inc; Rapid-Lok Fascia: [www.atas.com/#sle](http://www.atas.com/#sle).
  3. Drexel Metals Inc; Fascia: [www.drexmet.com/#sle](http://www.drexmet.com/#sle).
  4. Metal-Era Inc: [www.metalera.com/#sle](http://www.metalera.com/#sle).
  5. Metal Roofing Systems, Inc; Rapid Lock Coping: [www.metalroofingsystems.biz/#sle](http://www.metalroofingsystems.biz/#sle).
  6. OMG Roofing Products; Formed Coping Plus: [www.omgroofing.com/#sle](http://www.omgroofing.com/#sle).
  7. Substitutions: See Section 01 6000 - Product Requirements.

#### 2.02 COMPONENTS

- A. Copings: Factory fabricated to sizes required; mitered, welded corners; 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. Color: To be selected by Architect from manufacturer's custom range.

#### 2.03 FINISHES

- A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system; custom color to match approved sample.

#### 2.04 ACCESSORIES

- A. Sealant for Joints in Linear Components: As recommended by component manufacturer.

### 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.

#### 3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

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- B. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
- C. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.
- D. Coordinate installation of flashing flanges into reglets.

**END OF SECTION 07 7100**

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## SECTION 07 7200 ROOF ACCESSORIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Roof hatches.
- B. Preformed flashing sleeves

#### 1.02 REFERENCE STANDARDS

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for 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. Warranty Documentation:
  - 1. Submit manufacturer warranty.
  - 2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

#### 1.05 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

### PART 2 PRODUCTS

#### 2.01 ROOF HATCHES AND VENTS

- A. Roof Hatch Manufacturers:
  - 1. Precision Ladders, LLC; Model PH-G and integrated folding aluminum guard rail system AGRS-X: [www.precisionladders.com/#sle](http://www.precisionladders.com/#sle).
  - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
  - 1. Material: Galvanized steel, 14 gauge, 0.0747 inch thick.
  - 2. Finish: Factory prime paint.
  - 3. Insulation: Manufacturer's standard; 1 inch rigid glass fiber, located on outside face of curb.
- C. Metal Covers: Flush, insulated, hollow metal construction.
  - 1. Capable of supporting 40 psf live load.
  - 2. Material: Galvanized steel; outer cover 14 gauge, 0.0747 inch thick, liner 22 gauge, 0.03 inch thick.
  - 3. Finish: Factory prime paint.
  - 4. Insulation: Manufacturer's standard 1 inch rigid glass fiber.
  - 5. Gasket: Neoprene, continuous around cover perimeter.
- D. 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 load.
  - 2. Hinges: Heavy duty pintle type.

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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.
7. Extension post: Ladder extension safety post, by Bilco LU-1 or equivalent.

## **2.02 PREFORMED FLASHING SLEEVES**

- A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and slotted metal collar.
- B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.
  1. Manufacturers: Subject to compliance with requirements,

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.

### **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. 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 07 7200**

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## SECTION 07 8100 APPLIED FIRE PROTECTION

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Fireproofing of structural steel exposed to damage or moisture.

#### 1.02 REFERENCE STANDARDS

- A. UL (FRD) - Fire Resistance Directory.

#### 1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with placement of ceiling hanger tabs, mechanical component hangers, and electrical components.
- B. Preinstallation Meeting: Convene Three weeks minimum before starting work of this section.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
- B. Product Data: Provide data indicating product characteristics.
- C. Manufacturer's Installation Instructions: Indicate special procedures.

#### 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 FIELD CONDITIONS

- A. Do not apply fireproofing when temperature of substrate material and surrounding air is below 40 degrees F or when temperature is predicted to be below said temperature for 24 hours after application.
- B. Provide ventilation in areas to receive fireproofing during application and 24 hours afterward, to dry applied material.
- C. Provide temporary enclosure to prevent spray from contaminating air.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Applied Fireproofing:
  1. GCP Applied Technologies: [www.gcpat.com/#sle](http://www.gcpat.com/#sle).
  2. Isolatek International Corp: [www.isolatek.com/#sle](http://www.isolatek.com/#sle).
  3. Southwest Fireproofing Products Company: [www.sfrm.com/#sle](http://www.sfrm.com/#sle).
  4. Substitutions: See Section 01 6000 - Product Requirements.

#### 2.02 FIREPROOFING ASSEMBLIES

- A. Provide fire resistance ratings for following building elements as required by local building code:
  1. Primary structural frame, including columns, girders, and trusses, plates 1 hour.
  2. Roof construction, including supporting beams and joists, deck 1 hour.

#### 2.03 MATERIALS

- A. Applied Fireproofing Material: Manufacturer's standard factory mixed material, which when combined with water is capable of providing indicated fire resistance, and complying with following requirements:

#### 2.04 ACCESSORIES

- A. Primer Coating: Of type recommended by applied fireproofing manufacturer.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

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- A. Verify that surfaces are ready to receive fireproofing.
- B. Verify that clips, hangers, supports, sleeves, and other items required to penetrate fireproofing are in place.
- C. Verify that ducts, piping, equipment, or other items that would interfere with application of fireproofing have not been installed.
- D. Verify that voids and cracks in substrate have been filled.
- E. Verify that projections have been removed where fireproofing will be exposed to view as a finish material.

### **3.02 PREPARATION**

- A. Perform tests as recommended by fireproofing manufacturer in applications where adhesion of fireproofing to substrate is in question.
- B. Remove incompatible materials that could effect bond by scraping, brushing, scrubbing, or sandblasting.
- C. Prepare substrates to receive fireproofing in strict accordance with instructions of fireproofing manufacturer.
- D. Apply fireproofing manufacturer's recommended bonding agent on primed steel.
- E. Protect surfaces not scheduled for fireproofing and equipment from damage by overspray, fall-out, and dusting.
- F. Close off and seal duct work in areas where fireproofing is being applied.

### **3.03 APPLICATION**

- A. Apply primer adhesive in accordance with manufacturer's instructions.
- B. Apply fireproofing in uniform thickness and density as necessary to achieve required ratings.

### **3.04 FIELD QUALITY CONTROL**

- A. Perform field inspection and testing in accordance with Section 01 4000 - Quality Requirements.
- B. Inspect installed fireproofing after application and curing for integrity, prior to its concealment.
- C. Ensure that actual thicknesses, densities, and bond strengths meet requirements for specified ratings and requirements of authorities having jurisdiction (AHJ).
- D. Re-inspect installed fireproofing for integrity of fire protection, after installation of subsequent Work.

### **3.05 CLEANING**

- A. Remove excess material, overspray, droppings, and debris.
- B. Remove fireproofing from materials and surfaces not required to be fireproofed.

**END OF SECTION 07 8100**

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## SECTION 07 8123 INTUMESCENT FIRE PROTECTION

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Thin-film intumescent mastic fireproofing.
- B. Protective and/or decorative topcoats.

#### 1.02 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittals procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Performance characteristics and test results.
  - 2. Preparation instructions and recommendations.
  - 3. Storage and handling requirements and recommendations.
  - 4. Installation methods.
- C. Verification Samples: For each thickness, color, sheen, and finish required, submit samples not less than 4 inch square on designated substrate illustrating finished appearance.
- D. Field Quality Control Submittals: Submit field test report.

#### 1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company that specializes in manufacturing the type of products specified, with minimum of five years of documented experience.
- B. MOCK-UPS
  - 1. Provide a mock-up for evaluation of surface preparation techniques and application workmanship; approved mock-up will serve as a standard of comparison for subsequent work of this section.
  - 2. Finish at least 25 sq ft of steel in areas designated by Architect.
  - 3. Evaluate mock-up for compliance with specified requirements, including thickness and finish texture.
  - 4. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
  - 5. Refinish mock-up area as required to produce acceptable work.
  - 6. Approved mock-up may remain as part of the project.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Deliver materials in manufacturer's original, unopened containers with identification labels and testing agency markings intact and legible.
- C. Store products in manufacturer's unopened packaging until ready for installation.
  - 1. Store at temperatures not less than 50 degrees F in dry, protected area.
  - 2. Protect from freezing, and do not store in direct sunlight.
  - 3. Dispose of any materials that have come into contact with contaminants of any kind prior to application.
- D. Dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

#### 1.06 FIELD CONDITIONS

- A. Protect areas of application from windblown dust and rain.

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- B. Maintain ambient field conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under ambient conditions outside manufacturer's absolute limits.
  - 1. Provide temporary enclosures as required to control ambient conditions.
  - 2. Do not apply intumescent fireproofing when ambient temperatures are below 50 degrees F without specific approval from manufacturer.
  - 3. Maintain relative humidity between 40 and 60 percent in areas of application.
  - 4. Maintain ventilation in enclosed spaces during application and for not less than 72 hours afterward.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Intumescent Fire Protection:
  - 1. Albi Manufacturing Division of StanChem Inc: [www.albi.com/#sle](http://www.albi.com/#sle).
  - 2. Contego International, Inc: [www.contegointernational.com/#sle](http://www.contegointernational.com/#sle).
  - 3. Hilti, Inc: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
  - 4. Tnemec, Inc..
  - 5. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 SYSTEM REQUIREMENTS**

- A. Fireproofing: Provide intumescent thin-film fire protection coating systems tested by an independent testing agency in accordance with ASTM E119 and acceptable to authorities having jurisdiction (AHJ).
  - 1. Provide assemblies listed by UL or FM and bearing listing agency label or mark.
  - 2. Coating system to be for exterior use exposure.
- B. Structural Steel Columns: Fire resistance rating of 1 hour.
- C. Structural Steel Beams and Exposed Steel Deck: Fire resistance rating of 1 hour.
- D. All steel members: Fire resistance rating of 1 hour.

### **2.03 MATERIALS**

- A. Fire Resistive Coating System: Thin film intumescent mastic fireproofing system for fire protection of structural steel, gypsum board, wood, oriented strand board (OSB), concrete, and concrete masonry units (CMU).
  - 1. Surface Burning Characteristics: Tested in accordance with ASTM E84.
    - a. Flame Spread Index (FSI): 25, maximum.
    - b. Smoke Developed Index (SDI): 50, maximum.
  - 2. For Exterior Use:
    - a. Use only products without fiber content.
- B. Protective and Decorative Top Coating: As recommended by fireproofing manufacturer for exposure and substrate conditions.
  - 1. Color and Gloss: As indicated. Including custom colors to match.
- C. Sealers and Primer: As required by tested and listed assemblies, and recommended by fireproofing manufacturer to suit specific substrate conditions.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrates to determine if they are in satisfactory condition to receive intumescent fire protection; verify that substrates are clean and free of oil, grease, incompatible primers, or other foreign substances capable of impairing bond to fireproofing system.
- B. Do not begin installation until substrates have been properly prepared.
- C. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

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### **3.02 PREPARATION**

- A. Thoroughly clean surfaces to receive fireproofing.
- B. Repair substrates to remove surface imperfections that could effect uniformity of texture and thickness of fireproofing system, and remove minor projections and fill voids that could telegraph through finished work.
- C. Cover or otherwise protect other work that might be damaged by fallout or overspray of fireproofing system, and provide temporary enclosures as necessary to confine operations and maintain required ambient field conditions.

### **3.03 APPLICATION**

- A. Comply with manufacturer's instructions for particular conditions of installation applications.
- B. Apply manufacturer's recommended primer to required coating thickness.
- C. Apply fireproofing to full thickness over entire area of each substrate to be protected.
- D. Apply coats at manufacturer's recommended rate to achieve dry film thickness (DFT) as required for fire resistance ratings designated for each condition.
- E. Apply intumescent fire protection by spraying to maximum extent possible, and as necessary complete coverage by roller application or other method acceptable to manufacturer.
- F. Achieve uniform finished appearance complying with approved mock-up.

### **3.04 FIELD QUALITY CONTROL**

- A. Perform field inspection and testing in accordance with Section 01 4000 - Quality Requirements.
  - 1. Arrange for testing of installed intumescent fire protection by an independent testing laboratory using magnetic pull-off dry film thickness gage in accordance with SSPC-PA 2, and ensure it meets requirements of authorities having jurisdiction (AHJ).
  - 2. Submit field test reports promptly to Contractor and Architect.
- B. Repair or replace intumescent fire protection at locations where test results indicate fireproofing does not meet specified requirements.

### **3.05 CLEANING**

- A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.
- B. Immediately after installation of fireproofing in each area, remove overspray and fallout from other surfaces and clean soiled areas.

### **3.06 PROTECTION**

- A. Protect installed intumescent fire protection from damage due to subsequent construction activities, so fireproofing is without damage or deterioration before Date of Substantial Completion.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

**END OF SECTION 07 8123**

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## **SECTION 07 8400 FIRESTOPPING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Firestopping systems.

#### **1.02 REFERENCE STANDARDS**

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
- B. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus.
- C. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies.
- D. SCAQMD 1168 - Adhesive and Sealant Applications.

#### **1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Sustainable Design Submittal: Submit VOC content documentation for nonpreformed materials.
- C. Manufacturer's qualification statement.

#### **1.04 QUALITY ASSURANCE**

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

#### **1.05 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.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Firestopping Manufacturers:
  1. 3M Fire Protection Products: [www.3m.com/firestop/#sle](http://www.3m.com/firestop/#sle).
  2. Everkem Diversified Products, Inc; Intumescent Fire-Rated Putty Pads: [www.everkemproducts.com/#sle](http://www.everkemproducts.com/#sle).
  3. Hilti, Inc: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
  4. Specified Technologies Inc: [www.stifirestop.com/#sle](http://www.stifirestop.com/#sle).

#### **2.02 MATERIALS**

- A. Firestopping Materials: Any materials meeting requirements.
- B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

#### **2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS**

- A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
- B. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.

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- C. 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.

#### **2.04 FIRESTOPPING FOR PERIMETER CONTAINMENT**

- A. Perimeter Joint Systems That Have Movement Capabilities (Dynamic-D):
1. 2 Hour Construction: UL System CW-D-1004; Specified Technologies Inc. Fast Tack Firestop Spray.
  2. 2 Hour Construction: UL System CW-D-1011; Specified Technologies Inc. Fast Tack Firestop Spray.
  3. 2 Hour Construction: UL System CW-D-2042; Specified Technologies Inc. Fast Tack Firestop Spray.

#### **2.05 FIRESTOPPING FOR FLOOR-TO-FLOOR, FLOOR-TO-WALL, HEAD-OF-WALL, AND WALL-TO-WALL JOINTS**

- A. Concrete and Concrete Masonry Walls and Floors:
1. Head-of-Wall Joints at Concrete/Concrete Masonry Wall to Concrete Over Metal Deck Floor:

#### **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 INSTALLATION**

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

#### **3.03 CLEANING**

- A. Clean adjacent surfaces of firestopping materials.

**END OF SECTION 07 8400**

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## SECTION 07 9200 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 6116 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.

#### 1.03 REFERENCE STANDARDS

- A. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants.
- B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants.
- E. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants.
- F. ASTM C1311 - Standard Specification for Solvent Release Sealants.
- G. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
- H. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
- I. SCAQMD 1168 - Adhesive and Sealant Applications.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes 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. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
  - 4. Substrates the product should not be used on.
- 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. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- E. Sustainable Design Documentation: For sealants and primers, submit VOC content and emissions documentation as specified in Section 01 6116.

#### 1.05 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document covering installation requirements on site.
- B. Field Adhesion Tests of Joints: Test for adhesion using most appropriate method in accordance with ASTM C1521, or other applicable method as recommended by manufacturer.

#### 1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

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- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

## **PART 2 PRODUCTS**

### **2.01 ACCESSORIES**

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

## **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.

### **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.

### **3.03 INSTALLATION**

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Install bond breaker backing tape where backer rod cannot be used.
- D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- E. 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.
- F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

**END OF SECTION 07 9200**

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## SECTION 08 1113 HOLLOW METAL DOORS AND FRAMES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Fire-rated hollow metal doors and frames.
- C. Accessories, including glazing, louvers, and matching panels.

#### 1.02 RELATED REQUIREMENTS

- A. Section 08 7100 - Door Hardware.
- B. Section 09 9113 - Exterior Painting: Field painting.
- C. Section 09 9123 - Interior Painting: Field painting.

#### 1.03 ABBREVIATIONS AND ACRONYMS

- A. ANSI - American National Standards Institute.
- B. ASCE - American Society of Civil Engineers.
- C. HMMA - Hollow Metal Manufacturers Association.
- D. NAAMM - National Association of Architectural Metal Manufacturers.
- E. NFPA - National Fire Protection Association.
- F. SDI - Steel Door Institute.
- G. UL - Underwriters Laboratories.

#### 1.04 REFERENCE STANDARDS

- A. CBC 2019 CHAPTER 35
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.
- C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100).
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- G. 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.
- H. 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.
- I. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- J. ASTM E413 - Classification for Rating Sound Insulation.
- K. BHMA A156.115 - Hardware Preparation In Steel Doors And Steel Frames.
- L. ICC A117.1 - Accessible and Usable Buildings and Facilities.
- M. ITS (DIR) - Directory of Listed Products.
- N. NAAMM HMMA 805 - Recommended Selection and Usage Guide for Hollow Metal Doors and Frames.

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- O. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames.
- P. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames.
- Q. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames.
- R. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames.
- S. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
- T. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
- U. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames.
- V. UL (DIR) - Online Certifications Directory.
- W. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for 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.

#### **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. 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. Republic Doors: [www.republicdoor.com](http://www.republicdoor.com).
  - 2. Steelcraft, an Allegion brand: [www.allegion.com/#sle](http://www.allegion.com/#sle).
  - 3. Assa Abloy Ceko or Curries: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 DESIGN CRITERIA**

- A. Requirements for Hollow Metal Doors and Frames:
  - 1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to 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.

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5. Typical Door Face Sheets: Flush.
6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers 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.
8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
  - a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.
- B. Hollow Metal Panels: Same construction, performance, and finish as doors.
- C. 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 1 - Standard-duty.
    - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 1 - Full Flush.
    - d. Door Face Metal Thickness: 20 gage, 0.032 inch, minimum.
    - e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
  2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
  3. Door Thickness: 1-3/4 inch, nominal.
  4. Weatherstripping: Refer to Section 08 7100.
  5. Door Finish: Factory finished.
- B. Interior Doors, Non-Fire Rated:
  1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 1 - Standard-duty.
    - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 1 - Full Flush.
    - d. Door Face Metal Thickness: 20 gage, 0.032 inch, minimum.
    - e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
  2. Door Finish: Factory finished.
- C. Fire-Rated Doors:
  1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 1 - Standard-duty.
    - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 1 - Full Flush.
    - d. Door Face Metal Thickness: 20 gage, 0.032 inch, minimum.
    - e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
  2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
  3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
    - a. Attach fire rating label to each fire rated unit.

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4. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
5. Door Thickness: 1-3/4 inch, nominal.
6. Door Finish: Factory 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. Exterior Door Frames: Face 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 gage, 0.042 inch, minimum.
  3. Frame Finish: Factory primed and field finished.
  4. Weatherstripping: Integral, recessed into frame edge.
- C. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
  1. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
  2. Frame Finish: Factory finished.
- D. Door Frames, Fire-Rated: Knock-down type.
  1. Fire Rating: Same as door, labeled.
  2. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
  3. Frame Finish: Factory finished.
- E. Frames Wider than 48 inches: 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. Louvers: Roll formed steel with overlapping frame; finish same as door components ; factory-installed.
  1. Style: Standard straight slat blade.
  2. Fasteners: Exposed or concealed fasteners.
- B. 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.
- C. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

#### **2.07 FINISHES**

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

### **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. Install fire rated units in accordance with NFPA 80.

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- C. Coordinate frame anchor placement with wall construction.
- D. Install door hardware as specified in Section 08 7100.
- E. Coordinate installation of electrical connections to electrical hardware items.
- F. 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 measured with straight edge, corner to corner.

#### **3.05 ADJUSTING**

- A. Adjust for smooth and balanced door movement.
- B. Adjust sound control doors so that seals are fully engaged when door is closed.

**END OF SECTION 08 1113**

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## SECTION 08 3100 ACCESS DOORS AND PANELS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Wall and ceiling access door and frame units.

#### 1.02 RELATED REQUIREMENTS

- A. Section 09 9123 - Interior Painting: Field paint finish.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for 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. Project Record Documents: Record actual locations of each access unit.

#### 1.04 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:
  - 1. Location: As indicated on drawings.or as indicated in schedules.
  - 2. Material: Steel.
  - 3. Size: 12 inch by 12 inch.
  - 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
- B. Wall-Mounted Units in Wet Areas:
  - 1. Location: As indicated on drawings. or as indicated in schedules.
  - 2. Material: Steel, hot-dipped zinc, or zinc-aluminum-alloy coated.
  - 3. Size: 12 inch by 12 inch.
  - 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
- C. Ceiling-Mounted Units:
  - 1. Location: As indicated on drawings.or as indicated in schedules
  - 2. Material: Steel.
  - 3. Size - Lay-In Grid Ceilings: To match module of ceiling grid.
  - 4. Size - Other Ceilings: 12 inch by 12 inch. and 24 inch by 24inch.
  - 5. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

#### 2.02 WALL AND CEILING MOUNTED UNITS

- A. Manufacturers:
  - 1. ACUDOR Products Inc: [www.acudor.com/#sle](http://www.acudor.com/#sle).
  - 2. Babcock-Davis: [www.babcockdavis.com/#sle](http://www.babcockdavis.com/#sle).
  - 3. Karp Associates, Inc: [www.karpinc.com/#sle](http://www.karpinc.com/#sle).
  - 4. Milcor, Inc: [www.milcorinc.com/#sle](http://www.milcorinc.com/#sle).
  - 5. Nystrom, Inc: [www.nystrom.com/#sle](http://www.nystrom.com/#sle).
  - 6. Bilco Company; [www.bilco.com](http://www.bilco.com).

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.

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### **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 08 3100**

**SECTION 08 71 00**  
**DOOR HARDWARE**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.
- B. This Section includes the following, but is not necessarily limited to:
  - 1. Door Hardware, including electric hardware.
  - 2. Storefront and Entrance door hardware.
  - 3. Hold-open closers with smoke detectors.
  - 4. Thresholds, gasketing and weather-stripping.
  - 5. Door silencers or mutes.
- C. Related Sections: The following sections are noted as containing requirements that relate to this Section, but may not be limited to this listing.
  - 1. Division 8: Section - Steel Doors and Frames.
  - 2. Division 8: Section - Wood Doors.
  - 3. Division 8: Section - Aluminum Storefront
  - 4. Division 28: Section - Fire/Life-Safety Systems & Security Access Systems.

**1.03 REFERENCES (USE DATE OF STANDARD IN EFFECT AS OF BID DATE.)**

- A. 2019 California Building Code, CCR, Title 24.
- B. BHMA – Builders' Hardware Manufacturers Association
- C. CCR – California Code of Regulations, Title 24, Part 2, California State Accessibility Standards.
- D. DHI – Door and Hardware Institute
- E. NFPA - National Fire Protection Association.
  - 1. NFPA 80 - Fire Doors and Other Opening Protectives
  - 2. NFPA 105 - Smoke and Draft Control Door Assemblies
- F. UL - Underwriters Laboratories.
  - 1. UL 10C - Fire Tests of Door Assemblies
  - 2. UL 305 - Panic Hardware
- G. WHI - Warnock Hersey Incorporated
- H. SDI - Steel Door Institute

**1.04 SUBMITTALS & SUBSTITUTIONS**

- A. General: Submit in accordance with Conditions of the Contract and Division 1 Specification sections.
- B. Submit product data (catalog cuts) including manufacturers' technical product information for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
- C. Submit six (6) copies of schedule organized vertically into "Hardware Sets" with index of doors and headings, indicating complete designations of every item required for each door or opening. Include following information:
  - 1. Include a Cover Sheet with;
    - a. Job Name, location, telephone number.
    - b. Architects name, location and telephone number.
    - c. Contractors name, location, telephone number and job number.
    - d. Suppliers name, location, telephone number and job number.
    - e. Hardware consultant's name, location and telephone number.
  - 2. Job Index information included;
    - a. Numerical door number index including; door number, hardware heading number and page number.

- b. Complete keying information (referred to DHI hand-book "Keying Systems and Nomenclature"). Provision should be made in the schedule to provide keying information when available; if it is not available at the time the preliminary schedule is submitted.
  - c. Manufacturers' names and abbreviations for all materials.
  - d. Explanation of abbreviations, symbols, and codes used in the schedule.
  - e. Mounting locations for hardware.
  - f. Clarification statements or questions.
  - g. Catalog cuts and manufacturer's technical data and instructions.
3. Vertical schedule format sample:

Heading Number 1 (Hardware group or set number – HW -1)					
			(a) 1 Single Door #1 - Exterior from Corridor 101	(b) 90°	(c) RH
			(d) 3' 0"x7' 0" x 1-3/4" x (e) 20 Minute (f) WD x HM		
(g) 1	(h)	(i) ea	(j) Hinges - (k) 5BB1HW 4.5 x 4.5 NRP (l) ½ TMS	(m) 626	(n) IVE
2	6AA	1 ea	Lockset - ND50PD x RHO x RH x 10-025 x JTMS	626	SCH

(a) - Single or pair with opening number and location. (b) - Degree of opening (c) - Hand of door(s) (d) - Door and frame dimensions and door thickness. (e) - Label requirements if any. (f) - Door by frame material. (g) - (Optional) Hardware item line #. (h) - Keyset Symbol. (i) - Quantity. (j) - Product description. (k) - Product Number. (l) - Fastenings and other pertinent information. (m) - Hardware finish codes per ANSI A156.18. (n) - Manufacture abbreviation.

- D. Make substitution requests in accordance with Division 1. Substitution requests must be made prior to bid date. Include product data and indicate benefit to the project. Furnish samples of any proposed substitution.
- E. Wiring Diagrams: Provide product data and wiring and riser diagrams for all electrical products listed in the Hardware Schedule portion of this section.
- F. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
- G. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- H. Furnish as-built/as-installed schedule with close-out documents, including keying schedule and transcript, wiring/riser diagrams, manufacturers' installation and adjustment and maintenance information.
- I. Fire Door Assembly Testing: Submit a written record of each fire door assembly to the Owner to be made available to the Authority Having Jurisdiction (AHJ) for future building inspections.
- J. LEED Certification Points: Submit information and certifications necessary to achieve maximum points for LEED certification; coordinate and cooperate with Owner and Architect in providing information necessary for required LEED rating.

#### 1.05 QUALITY ASSURANCE

- A. Obtain each type of hardware (latch and lock sets, hinges, closers, exit devices, etc.) from a single manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.
  1. Responsible for detailing, scheduling and ordering of finish hardware.

1. Meet with Owner to finalize keying requirements and to obtain final instructions in writing. To maintain the integrity of patented key systems provide a letter of authorization from the specified manufacturer indicating that supplier has authorization to purchase the key system directly from the manufacturer.
2. Stock parts for products supplied and are capable of repairing and replacing hardware items found defective within warranty periods.
- C. Hardware Installer: Company specializing in the installation of commercial door hardware with five years documented experience.
- D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and tested by UL or Warnock Hersey for given type/size opening and degree of label. Provide proper latching hardware, door closers, approved-bearing hinges and seals whether listed in the Hardware Schedule or not.
  1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL label on exit devices indicating "Fire Exit Hardware".
- E. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.

#### **1.06 DELIVERY, STORAGE AND HANDLING**

- A. Coordinate delivery of packaged hardware items to the appropriate locations (shop or field) for installation.
- B. Hardware items shall be individually packaged in manufacturers' original containers, complete with proper fasteners. Clearly mark packages on outside to indicate contents and locations in hardware schedule and in work.
- C. Provide locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, etc.
- D. Contractor to inventory door hardware jointly with representatives of hardware supplier and hardware installer until each all are satisfied that count is correct.

#### **1.07 WARRANTY**

- A. Provide warranties of respective manufacturers' regular terms of sale from day of final acceptance as follows:
  1. Locksets: Three (3) years.
  2. Closers: Thirty (30) years
  3. All other hardware: Two (2) years.

#### **1.08 MAINTENANCE**

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

#### **1.09 PRE-INSTALLATION CONFERENCE**

- A. Convene a pre-installation conference at least one week prior to beginning work of this section.
- B. Attendance: Architect, Construction Manager, Contractor, Security Contractor, Hardware Supplier, Installer, Key Owner Personnel, and Project Inspector.
- C. Agenda: Review hardware schedule, products, installation procedures and coordination required with related work. Review Owner's keying standards.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

<u>Item</u>	<u>Manufacturer</u>	<u>Acceptable Substitutes</u>
Hinges	Ives	Hager, Stanley, McKinney
Locks, Latches	Schlage	None – District Standard
Exit Devices	Von Duprin	None – District Standard

Closers	LCN	None – District Standard
Push, Pulls & Protection Plates	Ives	Trimco, BBW, DCI
Flush Bolts	Ives	Trimco, BBW, DCI
Dust Proof Strikes	Ives	Trimco, BBW, DCI
Coordinators	Ives	Trimco, BBW, DCI
Stops	Ives	Trimco, BBW, DCI
Overhead Stops	Glynn-Johnson	Or Approved Equal
Thresholds	Zero	Pemko, National Guard
Seals & Bottoms	Zero	Pemko, National Guard

## 2.02 MATERIALS

- A. Hinges: Exterior out-swinging door butts shall be non-ferrous material and shall have stainless steel hinge pins. All doors to have non-rising pins.
  1. Hinges shall be sized in accordance with the following:
    - a. Height:
      - 1) Doors up to 42" wide: 4-1/2" inches.
      - 2) Doors 43" to 48" wide: 5 inches.
    - b. Width: Sufficient to clear frame and trim when door swings 180 degrees.
    - c. Number of Hinges: Furnish 3 hinges per leaf to 7'-5" in height. Add one for each additional 2 feet in height.
  2. Furnish non-removable pins (NRP) at all exterior out-swing doors and interior key lock doors with reverse bevels.
- B. Continuous Hinges: As manufactured by Ives, an Allegion Company. UL rated as required.
- C. Schlage "L" Series as scheduled with "06" Style Lever and "A" Style Rose.
  1. Locksets to comply with ANSI A156.13, Series 1000, Operational Grade 1 and Security Grade 1 with all standard trims. Locksets shall also comply with UL10C Positive Pressure requirements
  2. Lock case shall be manufactured with heavy 12 gauge steel with fully wrapped design. Lock cases with exposed edges are not acceptable. Lock case shall be multi-functional allowing transformation to a different function without opening lock case.
  3. Latchbolt shall have 3/4" throw and be non-handed, field reversible without opening the lock case. Solid latchbolts and / or plastic anti-friction devices are not acceptable.
  4. The deadbolt, when used, shall be 1" throw stainless steel with a 3/4" internal engagement when fully extended.
  5. All trim shall be through-bolted with the spring cages supporting the trim attached to the lock cases to prevent torqueing.
  6. Levers to have independent rotation in both directions. Exterior lever assembly to be one-piece design attached by threaded bushing. Interior lever assembly shall be attached by screwless shank
  7. Thru-bolt lever assemblies through the door for positive interlock. Locks using a through the door spindle for attachment are not acceptable. Spindles shall be independent, designed to "break-away" at a maximum of 75psi torque.
  8. Hand of lock chassis to be changeable by simply moving one screw from one side to the case to the other and pulling and reversing the latchbolt.
  9. Cylinders to be secured by a cast stainless steel, dual retainer. Locks utilizing screws and / or stamped retainers are not acceptable.

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10. All operable parts shall comply with CBC Section 11B-309.
- D. Closers: LCN as scheduled. Place closers inside building, stairs, room, etc.
  1. Door closer cylinders shall be of high strength cast iron construction with double heat treated pinion shaft to provide low wear operating capabilities of internal parts throughout the life of the installation. All door closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified testing laboratory. A written certification showing successful completion of a minimum of 10,000,000 cycles must be provided.
  2. All door closers shall be fully hydraulic and have full rack and pinion action with a shaft diameter of a minimum of 11/16 inch and piston diameter of 1 inch to ensure longevity and durability under all closer applications.
  3. All parallel arm closers shall incorporate one piece solid forged steel arms with bronze bushings. 1-9/16" steel stud shoulder bolts, shall be incorporated in regular arms, hold-open arms, arms with hold open and stop built in. All other closers to have forged steel main arms for strength, durability, and aesthetics for versatility of trim accommodation, high strength and long life.
  4. All parallel arm closers so detailed shall provide advanced backcheck for doors subject to severe abuse or extreme wind conditions. This advanced backcheck shall be located to begin cushioning the opening swing of the door at approximately 45 degrees. The intensity of the backcheck shall be fully adjustable by tamper resistant non-critical screw valve.
  5. Closers shall be installed to permit doors to swing 180 degrees.
  6. All closers shall utilize a stable fluid withstanding temperature range of 120 degrees F. to -30 degrees F. without requiring seasonal adjustment of closer speed to properly close the door.
  7. Provide the manufactures drop plates, brackets and spacers as required at narrow head rails and special frame conditions. NO wood plates or spacers will be allowed.
  8. Maximum effort to operate closers shall not exceed 5 lbs., such pull or push effort being applied at right angles to hinged doors. Compensating devices or automatic door operators may be utilized to meet the above standards. When fire doors are required, the maximum effort to operate the closer may be increased but shall not exceed 15 lbs. when specifically approved by fire marshal. All closers shall be adjusted to operate with the minimum amount of opening force and still close and latch the door. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position. Per 11B-404.2.8.1, door shall take at least 5 seconds to move from an open position of 90 degrees to a position of 12 degrees from the latch jamb.
- E. Flush Bolts & Dust Proof Strikes: Automatic Flush Bolts shall be of the low operating force design. Utilize the top bolt only model for interior doors where applicable and as permitted by testing procedures.
  1. Manual flush bolts only permitted on storage or mechanical openings as scheduled.
  2. Provide dust proof strikes at openings using bottom bolts.
- F. Door Stops:
  1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.
  2. Do not install floor stops more than four (4) inches from the face of the wall or partition (CBC Section 11B-307).
  3. Overhead stops shall be made of stainless steel and non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.
- G. Protection Plates: Fabricate either kick, armor, or mop plates with four beveled edges. Provide kick plates 10" high and 2" LDW. Sizes of armor and mop plates shall be listed in the Hardware Schedule. Furnish with machine or wood screws of bronze or stainless to match other hardware.
- H. Thresholds: As Scheduled and per details.
  1. Thresholds shall not exceed 1/2" in height, with a beveled surface of 1:2 maximum slope.

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2. Set thresholds in a full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements in Division 7 "Thermal and Moisture Protection".
3. Use ¼" fasteners, red-head flat-head sleeve anchors (SS/FHSL).
4. Thresholds shall comply with CBC Section 11B-404.2.5.
- I. Seals: Provide silicone gasket at all rated and exterior doors.
  1. Fire-rated Doors, Resilient Seals: UL10C Classified complies with NFPA 80 & NFPA 252. Coordinate with selected door manufacturers' and selected frame manufacturers' requirements.
  2. Fire-rated Doors, Intumescent Seals: Furnished by selected door manufacturer. Furnish fire-labeled opening assembly complete and in full compliance with UL10C Classified complies with NFPA 80 & NFPA 252. Where required, intumescent seals vary in requirement by door type and door manufacture -- careful coordination required.
  3. Smoke & Draft Control Doors, Provide UL10C Classified complies with NFPA 80 & NFPA 252 for use on "S" labeled Positive Pressure door assemblies.
- J. Door Shoes & Door Top Caps: Provide door shoes at all exterior wood doors and top caps at all exterior out-swing doors.
- K. Silencers: Furnish silencers for interior hollow metal frames, 3 for single doors, 2 for pairs of doors. Omit where sound or light seals occurs, or for fire-resistive-rated door assemblies.

### **2.03 KEYING**

- A. Furnish a Proprietary Schlage masterkey system as directed by the owner or architect. Key system to be designated and combined by the Schlage Master Key Department even if pinned by the Authorized Key Center, Authorized Security Center or a local authorized commercial dealer.
- B. A detailed keying schedule is to be prepared by the owner and/or architect in consultation with a representative of Allegion or an Authorized Key Center or Authorized Security Center. Each keyed cylinder on every keyed lock is to be listed separately showing the door #, key group (in BHMA terminology), cylinder type, finish and location on the door.
- C. Extend the original masterkey system established for the project
- D. Furnish all cylinders in the Schlage conventional style except the exit device and removable mullion cylinders which will be supplied in Schlage Full Size Interchangeable Core (FSIC). Pack change keys independently (PKI).
- E. Master key cylinders per District requirement.
- F. Furnish construction keying for doors requiring locking during construction.

### **2.04 FINISHES**

- A. Generally to be stainless steel US32D (630) unless otherwise noted.
- B. Furnish push plates, pull plates and kick or armor plates in satin stainless steel US32D (630) unless otherwise noted.
- C. Door closers shall be powder-coated to match other hardware, unless otherwise noted.
- D. Aluminum items to be finished anodized aluminum except thresholds which can be furnished as standard mill finish.

### **2.05 FASTENERS**

- A. Screws for strikes, face plates and similar items shall be flat head, countersunk type, provide machine screws for metal and standard wood screws for wood.
- B. Screws for butt hinges shall be flathead, countersunk, full-thread type.

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- C. Fastening of closer bases or closer shoes to doors shall be by means of sex bolts and spray painted to match closer finish.
- D. Provide expansion anchors for attaching hardware items to concrete or masonry.
- E. All exposed fasteners shall have a phillips head.
- F. Finish of exposed screws to match surface finish of hardware or other adjacent work.
- G. All Exit Devices and Lock Protectors shall be fastened to the door by the means of sex bolts or through bolts.

## **PART 3 - EXECUTION**

### **3.01 INSPECTION**

- A. Verify that doors and frames are square and plumb and ready to receive work and dimensions are as instructed by the manufacturer.
- B. Beginning of installation means acceptance of existing conditions.

### **3.02 INSTALLATION**

- A. Install hardware in accordance with manufacturer's instructions and requirements of DHI.
- B. Use the templates provided by hardware item manufacturer.
- C. Mounting heights for hardware shall be as recommended by the Door and Hardware Institute. Operating hardware will to be located between 34" and 44" AFF.
- D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- F. Set thresholds for exterior doors in full bed of butyl-rubber sealant.
- G. If hand of door is changed during construction, make necessary changes in hardware at no additional cost.

### **3.03 ADJUST AND CLEAN**

- A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.
- B. Clean adjacent surface soiled by hardware installation.
- C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy, return to that work area and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- D. Instruct Owner's Personnel in proper adjustment and maintenance of hardware finishes, during the final adjustment of hardware.
- E. Continued Maintenance Service: Approximately six months after the completion of the project, the Contractor accompanied by the Architectural Hardware Consultant, shall return to the project and re-adjust every item of hardware to restore proper functions of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

### **3.04 HARDWARE LOCATIONS**

- A. Conform to CCR, Title 24, Part 2; and ADAAG; and the drawings for access-compliant positioning requirements for the disabled.

### **3.05 FIELD QUALITY CONTROL**

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- A. Contractor is responsible for providing the services of an Architectural Hardware Consultant (AHC) or a proprietary product technician to inspect installation and certify that hardware and its installation have been furnished and installed in accordance with manufacturers' instructions and as specified herein.

### 3.06 SCHEDULE

- A. The items listed in the following schedule shall conform to the requirements of the foregoing specifications.
- B. While the hardware schedule is intended to cover all doors, and other movable parts of the building, and establish type and standard of quality, the contractor is responsible for examining the Plans and Specifications and furnishing proper hardware for all openings whether listed or not. If there are any omissions in hardware groups in regard to regular doors they shall be called to the attention of the Architect prior to bid opening for instruction; otherwise, list will be considered Complete. No extras will be allowed for omissions.
- C. The Door Schedule on the Drawings indicates which hardware set is used with each door.

#### Manufacturers Abbreviations (Mfr.)

GLY	=	Glynn-Johnson Corporation	Overhead Door Stops
IVE	=	Ives	Hinges, Pivots, Bolts, Coordinators, Dust Proof Strikes, Push Pull & Kick Plates, Door Stops & Silencers
LCN	=	LCN	Door Closers
SCH	=	Schlage Lock Company	Cylinders
ZER	=	Zero International	Thresholds, Gasketing & Weather-stripping

NOTE: Hardware (including panic hardware shall not be provided with Night Latch (NL) function for any accessible doors or gates unless:

- Has a dogging feature
- It is dogged during the time facilities are open
- Dogging operation is performed only by employees as their job function (non-public use)

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GROUP NO. 01

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	CORRIDOR W/DEADBOLT	LV9456P6 06A L583-363	630	SCH
1	EA	PRIMUS MORT. CYL.	20-776	626	SCH
1	EA	LOCK GUARD	LG1	630	IVE
1	EA	SURFACE CLOSER	4040XP SHCUSH SRI	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		ZER

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GROUP NO. 02

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	PRIVACY W/DB & IND	LV9496P6 06A L583-363	630	SCH
1	EA	PRIMUS MORT. CYL.	20-776	626	SCH
1	EA	LOCK GUARD	LG1	630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH SRI	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		ZER

GROUP NO. 03

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	LV9080P6 06A	630	SCH
1	EA	PRIMUS MORT. CYL.	20-776	626	SCH
1	EA	LOCK GUARD	LG1	630	IVE
1	EA	SURFACE CLOSER	4040XP SHCUSH SRI	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		ZER

GROUP NO. 04

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	CLASSROOM LOCK	LV9070P6 06A	630	SCH
1	EA	PRIMUS MORT. CYL.	20-776	626	SCH
1	EA	LOCK GUARD	LG1	630	IVE
1	EA	SURFACE CLOSER	4040XP EDA SRI	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	626	IVE
1	EA	FLOOR STOP/HOLDER	FS43	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		ZER

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GROUP NO. 05

6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	CONST LATCHING BOLT	FB51T	630	IVE
1	EA	STOREROOM LOCK	LV9080P6 06A	630	SCH
1	EA	PRIMUS MORT. CYL.	20-776	626	SCH
2	EA	OH STOP & HOLDER	90H	630	GLY
1	EA	GASKETING	188SBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	ASTRAGAL	43SP	SP	ZER
1	EA	THRESHOLD	PER DETAIL		ZER

GROUP NO. 06

6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	CONST LATCHING BOLT	FB51T	630	IVE
1	EA	STOREROOM LOCK	LV9080P6 06A	630	SCH
1	EA	PRIMUS MORT. CYL.	20-776	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH SRI	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	ASTRAGAL	43SP	SP	ZER
1	EA	THRESHOLD	PER DETAIL		ZER

GROUP NO. 07

6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	CLASSROOM LOCK	LV9070P6 06A	630	SCH
1	EA	PRIMUS MORT. CYL.	20-776	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH SRI	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	ASTRAGAL	43SP	SP	ZER
1	EA	THRESHOLD	PER DETAIL		ZER

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GROUP NO. 08

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	PRIVACY WITH INDICATOR	L9056P6 06A L583-363 L283-722	630	SCH
1	EA	PRIMUS MORT. CYL.	20-776	626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	626	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE

GROUP NO. 09

6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	PANIC HARDWARE	PA-AX-9927-EO-LBR	626	VON
1	EA	PANIC HARDWARE	PA-AX-9927-L-NL-06-LBR	626	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH SRI	689	LCN
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	328AA	AA	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		ZER

GROUP NO. 10

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	LV9080P6 06A	630	SCH
1	EA	PRIMUS MORT. CYL.	20-776	626	SCH
1	EA	LOCK GUARD	LG1	630	IVE
1	EA	SURFACE CLOSER	4040XP SHCUSH SRI	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		ZER

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GROUP NO. 11

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	CLASSROOM LOCK	LV9070P6 06A	630	SCH
1	EA	PRIMUS MORT. CYL.	20-776	626	SCH
1	EA	LOCK GUARD	LG1	630	IVE
1	EA	SURFACE CLOSER	4040XP SHCUSH SRI	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	PER DETAIL		ZER

**END OF SECTION**

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## SECTION 08 8000 GLAZING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Insulating glass units.
- B. Glazing compounds.

#### 1.02 REFERENCE STANDARDS

- A. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
- B. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
- C. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings.
- D. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.
- E. NFRC 100 - Procedure for Determining Fenestration Product U-factors.
- F. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.
- G. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data on Insulating Glass Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Warranty Documentation: 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 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.
    - a. Safety Glazing Certification Council (SGCC).

#### 1.05 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

### PART 2 PRODUCTS

#### 2.01 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.

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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:
- 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.

## 2.02 GLASS MATERIALS

### 2.03 INSULATING GLASS UNITS

- A. Manufacturers:
  1. AGC Glass North America, Inc: [www.agcglass.com/#sle](http://www.agcglass.com/#sle).
  2. Pilkington North America Inc: [www.pilkington.com/na/#sle](http://www.pilkington.com/na/#sle). Pilkington North America Inc: [www.pilkington.com/na/#sle](http://www.pilkington.com/na/#sle).
  3. Viracon, Apogee Enterprises, Inc: [www.viracon.com/#sle](http://www.viracon.com/#sle).
  4. Vitro Architectural Glass (formerly PPG Glass): [www.vitroglazings.com/#sle](http://www.vitroglazings.com/#sle).
  5. Substitutions: See Section 01 6000 - 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; or coated spandrel glass, Kind CS.
  3. Spacer Color: Black.
  4. Edge Seal:
    - a. Color: Black.
  5. Purge interpane space with dry air, hermetically sealed.

### 2.04 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 air.
  3. Total Thickness: 1 inch.
  4. Thermal Transmittance (U-Value): [\_\_\_\_], nominal.
  5. Visible Light Transmittance (VLT): [\_\_\_\_] percent, nominal.
  6. Shading Coefficient: [\_\_\_\_], nominal.
  7. Solar Heat Gain Coefficient (SHGC): [\_\_\_\_], nominal.
  8. Glazing Method: Dry glazing method, gasket glazing.
  9. 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; or coated spandrel glass, Kind CS.
  10. Spacer Color: Black.
  11. Edge Seal:
  12. Color: Black.
  13. Purge interpane space with dry air, hermetically sealed.

## 2.05 ACCESSORIES

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- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.
- B. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

## **2.06 SOURCE QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Provide shop inspection and testing for all 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 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.

### **3.02 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.

### **3.03 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 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.

### **3.04 FIELD QUALITY CONTROL**

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

### **3.05 CLEANING**

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove nonpermanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. 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.

### **3.06 PROTECTION**

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

**END OF SECTION 08 8000**

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## SECTION 08 9100 LOUVERS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Louvers, frames, and accessories.

#### 1.02 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- B. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
- C. Test Reports: Independent agency reports showing compliance with specified performance criteria.

#### 1.04 QUALITY ASSURANCE

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

#### 1.05 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Louvers:

#### 2.02 LOUVERS

- A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.

#### 2.03 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).

#### 2.04 FINISHES

- A. High Performance Organic Coating: Primer and silicone-modified polyester (SMP) enamel topcoat with minimum dry film thickness (DFT) of 1.2 mils, 0.0012 inch over aluminum extrusions and panels; AAMA 2604.

#### 2.05 ACCESSORIES

- A. Blank-Off Panels: Specified in Section 23 3100.
- B. Bird Screen: Interwoven wire mesh of steel, 14 gage, 0.0641 inch diameter wire, 1/2 inch open weave, diagonal design.
- C. Fasteners and Anchors: Stainless steel.
- D. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

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- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- D. Secure louver frames in openings with concealed fasteners.

### **3.02 CLEANING**

- A. Strip protective finish coverings.

**END OF SECTION 08 9100**

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## SECTION 09 2116 GYPSUM BOARD ASSEMBLIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Metal channel ceiling framing.
- B. Gypsum wallboard.
- C. Joint treatment and accessories.

#### 1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 07 2100 - Thermal Insulation: Acoustic insulation.
- C. Section 07 8400 - Firestopping: Top-of-wall assemblies at fire rated walls.
- D. Section 07 9200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
- E. Section 09 3000 - Tiling: Tile backing board.

#### 1.03 REFERENCE STANDARDS

- A. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units.
- B. ANSI A108/A118/A136.1 - Specifications for the Installation of Ceramic Tile.
- C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.
- E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
- H. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
- I. 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.
- J. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- K. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing.
- L. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units.
- M. ASTM C1396/C1396M - Standard Specification for Gypsum Board.
- N. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- O. GA-216 - Application and Finishing of Gypsum Panel Products.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
- C. Product Data: Provide data on gypsum board, accessories, and joint finishing system.

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## **PART 2 PRODUCTS**

### **2.01 GYPSUM BOARD ASSEMBLIES**

- A. Provide completed assemblies complying with ASTM C840 and GA-216.

### **2.02 METAL FRAMING MATERIALS**

- A. Non-Loadbearing Framing System Components: ASTM C645; 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.
1. Studs: "C" shaped with flat or formed webs with knurled faces.
  2. Runners: U shaped, sized to match studs.
  3. Ceiling Channels: C-shaped.

### **2.03 BOARD MATERIALS**

- A. Manufacturers - Gypsum-Based Board:
1. Georgia-Pacific Gypsum: [www.gpgypsum.com/#sle](http://www.gpgypsum.com/#sle).
  2. National Gypsum Company: [www.nationalgypsum.com/#sle](http://www.nationalgypsum.com/#sle).
  3. USG Corporation: [www.usg.com/#sle](http://www.usg.com/#sle).
- 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 vertical surfaces and ceilings, unless otherwise indicated.
  2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
  3. Thickness:
    - a. Vertical Surfaces: 5/8 inch.
    - b. Ceilings: 1/2 inch.
- C. Impact Resistant Wallboard:
1. Application: High-traffic areas indicated.
  2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  3. Type: Fire resistance rated Type X, UL or WH listed.
  4. Thickness: 5/8 inch.
  5. Edges: Tapered.
- D. Backing Board For Wet Areas: One of the following products:
1. Application: Surfaces behind tile in wet areas including tub and 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.
- E. 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: Vertical surfaces behind thinset tile, except in wet areas.
  2. Type: Regular and Type X, in locations indicated.
  3. Type X Thickness: 5/8 inch.
  4. Regular Board Thickness: 1/2 inch.
  5. Edges: Tapered.
- F. 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: Ceilings, unless otherwise indicated.
  2. Edges: Tapered.

### **2.04 ACCESSORIES**

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- A. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- B. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
  - 1. Rigid Corner Beads: Low profile, for 90 degree outside corners.
- C. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
- D. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.
- E. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that project conditions are appropriate for work of this section to commence.

#### **3.02 FRAMING INSTALLATION**

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
- C. Studs: Space studs at 16 inches 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.
- D. Blocking: Install wood blocking for support of:
  - 1. Framed openings.
  - 2. Wall mounted cabinets.
  - 3. Plumbing fixtures.
  - 4. Toilet partitions.
  - 5. Toilet accessories.
  - 6. Wall mounted door hardware.

#### **3.03 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. Acoustic Sealant: Install in accordance with manufacturer's instructions.

#### **3.04 BOARD INSTALLATION**

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

#### **3.05 INSTALLATION OF TRIM AND ACCESSORIES**

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
  - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
  - 2. At exterior soffits, not more than 30 feet apart in both directions.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

#### **3.06 JOINT TREATMENT**

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.

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2. Level 1: Fire 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.

### **3.07 TOLERANCES**

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

**END OF SECTION 09 2116**

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## SECTION 09 5100 ACOUSTICAL CEILINGS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

#### 1.02 REFERENCE STANDARDS

- A. CBC 2019 chapter 35
- B. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- E. 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.
- F. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.
- G. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests.
- H. CHPS (HPPD) - High Performance Products Database.
- I. ASCE 7 - Minimum Design Loads for buildings and Other Structures; 2010.
- J. CBC Section 1705 - California Building Code Section 1705A; Statement of Special Inspections.
- K. UL (FRD) - Fire Resistance Directory.
- L. UL (GGG) - GREENGUARD Gold Certified Products.

#### 1.03 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.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components.
- D. Samples: Submit two full size samples illustrating material and finish of acoustical units.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.
- G. Research/Evaluation Reports: Current ICC-ES reports for each acoustical panel ceiling and suspension components, including anchor and fastener types.

#### 1.05 QUALITY ASSURANCE

- A. Seismic Design: CBC Seismic Design Category E, including:
  - 1. Requirements of the Division of the State Architect (DSA) for seismic-resistant design and installation of ceiling suspension systems, including DSA Interpretation of Regulations, IR 25-5.

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## 1.06 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, 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; BASIS OF DESIGN: [www.armstrong.com](http://www.armstrong.com).
  - 2. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
  - 3. USG: [www.usg.com](http://www.usg.com).
- B. Suspension Systems:
  - 1. Same as for acoustical units.
  - 2. Substitutions: See Section 01 6000 - Product Requirements.

### 2.02 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
  - 1. VOC Content: As specified in Section 01 6116.
- B. Acoustical Tile: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:
  - 1. Size: 24 x 28 inches
  - 2. Thickness: 7/8 inches.
  - 3. Composition: Water felted.
  - 4. Smoke Developed Index: 50 or less (UL Labeled)
  - 5. Flame Spread Index: 25 or less
  - 6. Light Reflectance: .87 percent, determined in accordance with ASTM E1264.
  - 7. NRC Range: .75 to .80, determined in accordance with ASTM E1264.
  - 8. Articulation Class (AC): 170, determined in accordance with ASTM E1264.
  - 9. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
  - 10. Edge: Square.
  - 11. Surface Color: White.
  - 12. Surface Pattern: Non-directional fissured.
  - 13. Suspension System: Exposed Grid.
  - 14. Products:
    - a. Armstrong Ultima High NRC.

### 2.03 SUSPENSION SYSTEM(S)

- A. Suspension Systems - General: Complying with ASTM C635/C635M and ASTM E580; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
- B. Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635 and per current DSA IR 25-2.13.
- C. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
  - 1. Profile: Tee; 15/16 inch wide face. BOD. Armstrong Prelude Product 7301 Main Runner, 7328 / 7342 Cross Runner, 7800 Wall angle.
  - 2. Construction: Double web.
  - 3. Finish: White painted.
  - 4. Seismic Clips: BERC2; ESR 1308
  - 5. Products:
    - a. BOD: Armstrong Prelude XL 15/16", ESR 1308.
    - b. Substitutions: See Section 01 6000 - Product Requirements.

### 2.04 ACCESSORIES

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- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Seismic Bracing: Manufacturer's standard perimeter stabilizer bars, compression struts, and seismic ceiling panel clips designed to accommodate seismic forces.
- C. Perimeter Moldings: Same material and finish as grid.
  - 1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
  - 2. Where detailed: Axiom vertical trim, height as detailed, match grid color/finish.
- D. Touch-up Paint: Type and color to match acoustical and grid units.
- E. Ties: Provide wires complying with the following requirements:
  - 1. Zinc-Coated, carbon-steel wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
  - 2. Size: Select wire diameter so its stress at 3 times hanger desing load (ASTM C635, Table 1 'Direct Hung') will be less than yield stress of wire, but provide not less than 0.106-ince (12 ga.W&M) diameter wire.
- F. Seismic Stabilizer Bars: Per approved Drawings.
- G. Seismic Struts: Per approved Drawings.
- H. Seismic Clips: Manufacturer's standard seismic clips design and spaced to secure acoustical panels in place.

### **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 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. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. 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.
- F. 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.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.
- J. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
  - 1. Use longest practical lengths.
  - 2. Overlap and rivet corners.

#### **3.03 INSTALLATION - ACOUSTICAL UNITS**

- A. Install acoustical units in accordance with manufacturer's instructions.

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- 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 units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
  - 1. Make field cut edges of same profile as factory edges.
  - 2. Double cut and field paint exposed reveal edges.
- G. Where round obstructions occur, provide preformed closures to match perimeter molding.
- H. For acoustic baffles: All wet work must be complete and dry prior to installation. Avoid direct exposure Soft Sound® to sunlight or warranty will be void. 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 product or warranty will be void.

#### **3.04 FIELD QUALITY CONTROL**

- A. Regulatory Requirements: Special tests and inspections for suspended ceiling systems and anchorages per CBC Section 1705.3.
- B. Remove and replace acoustical panel ceiling hangers and anchors and fasteners that do not pass tests and inspections and retest as specified above.
- C. Prepare test and inspection reports.

#### **3.05 TOLERANCES**

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

**END OF SECTION 09 5100**

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## SECTION 09 6700 FLUID-APPLIED FLOORING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Fluid-applied flooring and base.
- B. Divider strips and accessories.

#### 1.02 REFERENCE STANDARDS

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.
- C. Samples: Submit two samples, 6 by 6 inch in size illustrating color and pattern for each floor material for each color specified.

#### 1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the work of this section.
- B. Supervisor Qualifications: Trained by product manufacturer , under direct full time supervision of manufacturer's own foreman.

#### 1.05 MOCK-UP

- A. Construct mock-up(s) of fluid applied flooring to serve as basis for evaluation of texture and workmanship.
  - 1. Number of Mock-Ups to be Prepared: One.
  - 2. Use same materials and methods for use in the work.
  - 3. Use approved design samples as basis for mock-ups.
  - 4. Locate where directed.
  - 5. Minimum Size: 48 inches by 48 inches.
- B. Obtain approval of mock-up by Architect before proceeding with work.
- C. Approved mock-up may remain as part of the Work.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store resin materials in a dry, secure area.
- B. Store materials for three days prior to installation in area of installation to achieve temperature stability.

#### 1.07 FIELD CONDITIONS

- A. Maintain minimum temperature in storage area of 55 degrees F.
- B. Store materials in area of installation for minimum period of 24 hours prior to installation.
- C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

### PART 2 PRODUCTS

#### 2.01 FLUID-APPLIED FLOORING SYSTEMS

- A. Fluid-Applied Flooring: Epoxy base coat(s), with broadcast aggregate. Integral base system.
  - 1. Primer: Stonhrad standard primer
  - 2. Mortar Base: Stonshield HRI base
  - 3. Undercoat: Stonshield undercoat
  - 4. Broadcast: Stonshield quartz aggregate, pigmented
  - 5. Sealer: Stonkote CE4
  - 6. System Thickness: 1/4 inch, nominal, when dry.

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7. Texture: Slip resistant.
8. Sheen: Clear gloss.
9. Anti-microbial additive
10. Color: As indicated in drawings.
11. Basis of Design Product: Floors/Wall Base Stonhard, Inc.; Stonshield HRI. Walls: Stonglaze VSR.

## **2.02 ACCESSORIES**

- A. Base Caps: Extruded mill finished aluminum with projecting base of 1/8 inch; color as selected.
- B. Cant Strips: Molded of flooring resin material.
- C. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.
- D.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.
- 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 flooring.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are ready for flooring installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within the following limits:
  1. Moisture emission rate: Not greater than 3 lb per 1000 sq ft per 24 hours, tested according to ASTM F1869.

### **3.02 PREPARATION**

- A. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with sub-floor filler.
- B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.
- C. Vacuum clean substrate.
- D. Apply primer to surfaces required by flooring manufacturer.

### **3.03 INSTALLATION - FLOORING**

- A. Apply in accordance with manufacturer's instructions.
- B. Finish to smooth level surface.

### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B.

### **3.05 PROTECTION**

- A. Prohibit traffic on floor finish for 48 hours after installation.
- B. Barricade area to protect flooring until fully cured.

**END OF SECTION 09 6700**

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## SECTION 09 9113 EXTERIOR PAINTING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
  - 1. Concrete.
  - 2. Steel, primed steel and galvanized metal.

#### 1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.
  - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
  - 2. Step coats on Samples to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
  - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
  - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

#### 1.03 QUALITY ASSURANCE

- A. MPI Standards:
  - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
  - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
- B. Paints and surface preparation agents such as but not limited to epoxy paint removers containing methylene chloride (dichloromethane, CAS 75-09-2) are not allowed.
- C. Substitution of materials not meeting the criteria in this section and products containing 1/10th of 1% (0.1%) or more of any OSHA or Cal/OSHA, NTP or ARC listed carcinogens shall be clearly identified during submittal process and require approval by Owner. In substitutions, must have a detailed written justification, technical data sheets, MSDS and to be submitted not less than 10 working days in advance of the planned use of the non-complying material. Failure to comply with these requirements will be grounds for rejection.
- D. The use of two-component polyurethane paint systems in occupied sites is not allowed.
- E. All paints and coatings must meet the California Air Resources Board (CARB) and Bay Air Quality Management District (BAQMD) current standards and regulations.
- F. Recycled paints are not allowed.
- G. If an architectural coating is recommended for more than use, the most restrictive VOC limit shall apply.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

#### 1.05 PROJECT CONDITIONS

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- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

#### **1.06 EXTRA MATERIALS AND CLOSEOUT DOCUMENTS**

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
  - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.
  - 2. Provide final schedule of colors with formulas for each paint color and sheen.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Basis of Design: Sherwin Williams Company.
  - 2. Kelly Moore Paint Company.
  - 3. Benjamin Moore Company.
  - 4. Dunn Edwards Company

#### **2.02 PAINT, GENERAL**

- A. Material Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Colors: As selected by Architect from manufacturer's full range. Refer to drawings.
- C. Concrete and Masonry: Where paint is indicated to be semi-gloss (40-50 gloss factor).
- D. CMU, Masonry and Concrete: Provide water and graffiti repelent by Prosoco, "Blok Guard and Graffiti Control Ultra" coating.
- E. Paint to be three-coat, primer and two finish coats, back rolled. Color tint sealers and undercoats to correspond with finish color.

#### **2.03 BLOCK FILLERS**

- A. Interior/Exterior Latex Block Filler: MPI #4.
  - 1. VOC Content: E Range of E3.

#### **2.04 METAL PRIMERS**

- A. Waterborne Galvanized-Metal Primer: MPI #134.
  - 1. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
  - 2. Use primer with a VOC content of 100g/L (0.83 lb/gal) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    - a. VOC Content: E Range of E3.
    - b. Environmental Performance Rating: EPR 3.
    - c. Lead and Chromate free.
  - 3. Products:
    - a. Carboline Company; Carbozinc 859 VOC.
    - b. International Coatings Limited; Interzinc 437 Inorganic Zinc-Rich Primer.
    - c. Tnemec Company, Inc.; Series 94-H2O-Hydro-Zinc.
    - d. ZRC Worldwide, ZRC Zero-VOC Galvanizing Compound.

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4. Provide written verification of compatibility with topcoats.
- B. Quick-Drying Primer for Aluminum: MPI #95.
  1. VOC Content: E Range of E3.

## **2.05 FLOOR COATINGS**

- A. Interior/Exterior Clear Concrete Floor Sealer (Water Based): MPI #99.
  1. VOC Content: E Range of E3.

## **2.06 OWNER PREFERRED PRODUCTS**

- A. Polyurethane System Primer - Aluminum
  1. Procryl Acrylic Universal Primer B66W00-310
- B. Polyurethane System Finish
  1. High Solids Polyurethane B65 - 100 Series, B65-625
- C. Polyurethane System Hardener
  1. B65-V625
- D. Polyurethane System Primer - Galvanized Steel/Ferrous
  1. Procryl Universal Primer B66W00-310
- E. Polyurethane System Primer - Ferrous
  1. Water Based Macropoxy 646 Primer

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  1. Concrete: 12 percent.
  2. Masonry (Clay and CMU): 12 percent.
  3. Wood: 15 percent.
  4. Plaster: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

### **3.02 PREPARATION**

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
  1. All shop-primed items are to be fully re-primed in the field.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
  2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

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- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Plaster Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- F. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- G. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- H. Zinc-Rich Primed and Galvanized-Metal Substrates: Acid wash all galvanized materials to remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched and prime surfaces that promote adhesion of subsequently applied paints.
- I. Protect planting adjacent to buildings.

### **3.03 APPLICATION**

- A. Apply paints according to manufacturer's written instructions.
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

### **3.04 CLEANING AND PROTECTION**

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### **3.05 EXTERIOR PAINTING SCHEDULE**

- A. CMU Substrates:
  - 1. Prime Coat: Interior/exterior latex block filler.
  - 2. Intermediate Coat: Exterior latex matching topcoat.
  - 3. Topcoat: Exterior latex (eggshell) .
- B. Steel, Galvanized and Zinc-Rich Primed-Metal Substrates:
  - 1. Prime Coat: Galvanized-metal primer.
  - 2. Intermediate Coat: Exterior latex matching topcoat.
  - 3. Topcoat: Exterior latex (semigloss).

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C. Aluminum Substrates:

1. Prime Coat: Quick-drying primer for aluminum.
2. Intermediate Coat: Exterior latex matching topcoat.
3. Topcoat: Exterior latex (semigloss).

**END OF SECTION 099113 09 9113**

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## SECTION 09 9123 INTERIOR PAINTING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
  - 1. Concrete.
  - 2. Steel.
  - 3. Galvanized metal.
  - 4. Aluminum (not anodized or otherwise coated).
  - 5. Wood.
  - 6. Gypsum board.

#### 1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
  - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
  - 2. Step coats on Samples to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
  - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
  - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

#### 1.03 QUALITY ASSURANCE

- A. MPI Standards:
  - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
  - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
- B. Paints and surface preparation agents such as but not limited to epoxy paint removers containing methylene chloride (dichloromethane, CAS 75-09-2) are not allowed.
- C. Substitution of materials not meeting the criteria in this section and products containing 1/10th of 1% (0.1%) or more of any OSHA or Cal/OSHA, NTP or ARC listed carcinogens shall be clearly identified during submittal process and require approval by Owner. In substitutions, must have a detailed written justification, technical data sheets, MSDS and to be submitted not less than 10 working days in advance of the planned use of the non-complying material. Failure to comply with these requirements will be grounds for rejection.
- D. The use of two-component polyurethane paint systems in occupied sites is not allowed.
- E. All paints and coatings must meet the California Air Resources Board (CARB) and Bay Air Quality Management District (BAQMD) current standards and regulations.
- F. Recycled paints are not allowed.
- G. EPA Method 24 VOC testing is standard for all paints.
- H. If an architectural coating is recommended for more than use, the most restrictive VOC limit shall apply.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

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- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

#### **1.05 PROJECT CONDITIONS**

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

#### **1.06 EXTRA MATERIALS AND CLOSEOUT DOCUMENTS**

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
  - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.
  - 2. Provide final schedule of colors with formulas for each paint color and sheen.
  - 3. Provide a floor plan with location of each paint color formulas.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Basis of Design: Sherwin Williams Company.
  - 2. Benjamin Moore Company.
  - 3. Kelly Moore Paint Company.
  - 4. Dunn-Edwards Corporation.

#### **2.02 PAINT, GENERAL**

- A. Material Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
  - 1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
  - 2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
  - 3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
  - 4. Floor Coatings: VOC not more than 100 g/L.
  - 5. Shellacs, Clear: VOC not more than 730 g/L.
  - 6. Shellacs, Pigmented: VOC not more than 550 g/L.
  - 7. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
- C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
  - 1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

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2. Restricted Components: Paints and coatings shall not contain any of the following:

- a. Acrolein.
- b. Acrylonitrile.
- c. Antimony.
- d. Benzene.
- e. Butyl benzyl phthalate.
- f. Cadmium.
- g. Di (2-ethylhexyl) phthalate.
- h. Di-n-butyl phthalate.
- i. Di-n-octyl phthalate.
- j. 1,2-dichlorobenzene.
- k. Diethyl phthalate.
- l. Dimethyl phthalate.
- m. Ethylbenzene.
- n. Formaldehyde.
- o. Hexavalent chromium.
- p. Isophorone.
- q. Lead.
- r. Mercury.
- s. Methyl ethyl ketone.
- t. Methyl isobutyl ketone.
- u. Methylene chloride.
- v. Naphthalene.
- w. Toluene (methylbenzene).
- x. 1,1,1-trichloroethane.
- y. Vinyl chloride.

D. Colors: As selected by Architect from manufacturer's full range.

E. Doors and Frames: To be one color (Unless Noted Otherwise in drawings), gloss enamel paint.

F. Wood: To be semi-gloss painted, or stained, polyurethane clear finish for decorative wood doors, casework and benches.

G. Main Distribution Frame Back Board: Provide fire proof paint.

H. Paint to be three-coat, primer and two finish coats, back rolled; unless four coat system is specified.

### 2.03 BLOCK FILLERS

A. Interior/Exterior Latex Block Filler: MPI #4.

1. VOC Content: E Range of E3.

### 2.04 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 3.

B. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

### 2.05 METAL PRIMERS

A. Rust-Inhibitive Primer (Water Based): MPI #107.

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 3.

B. Waterborne Galvanized-Metal Primer: MPI #134.

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 3.

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- C. Quick-Drying Primer for Aluminum: MPI #95.
  - 1. VOC Content: E Range of E3.

## **2.06 WOOD PRIMERS**

- A. Interior Latex-Based Wood Primer: MPI #39.
  - 1. VOC Content: E Range of E3.
  - 2. Environmental Performance Rating: EPR 3.

## **2.07 LATEX PAINTS**

- A. Institutional Low-Odor/VOC Latex (Flat): MPI #143 (Gloss Level 1).
  - 1. VOC Content: E Range of E3.
  - 2. Environmental Performance Rating: EPR 4.
- B. Institutional Low-Odor/VOC Latex (Eggshell): MPI #145 (Gloss Level 3).
  - 1. VOC Content: E Range of E3.
  - 2. Environmental Performance Rating: EPR 4.5.
- C. Institutional Low-Odor/VOC Latex (Semigloss): MPI #147 (Gloss Level 5).
  - 1. VOC Content: E Range of E3.
  - 2. Environmental Performance Rating: EPR 3.

## **2.08 FLOOR COATINGS**

- A. Where interior floor finishes are called out to be "sealed".
- B. Interior Clear Concrete Floor Sealer (Water Based): MPI #99.
  - 1. VOC Content: E Range of E3.

## **2.09 OWNER PREFERRED PRODUCTS**

- A. Polyurethane System Primer - Galvanized Steel/Ferrous
  - 1. Pro Industrial Pro-Cryl Universal Primer B66W00-310
- B. Polyurethane System Finish - Galvanized Steel/Ferrous
  - 1. High Solids Polyurethane 100 Series B65W00625
- C. Polyurethane System Hardener - Galvanized Steel/Ferrous
  - 1. Primer: B58v620
  - 2. Finish: B65v625
- D. Polyurethane System Primer - Ferrous
  - 1. Macropoxy 646 - 100 Fast Cure Epoxy Primer B58W00620
- E. Interior Wood Paint - Primer
  - 1. Premium Wall and Wood Primer B28W8111
- F. Interior Wood Clear Finish
  - 1. Wood benches in locker rooms to be marine type
- G. Interior Drywall Primer
  - 1. Promar 200 Interior Latex Primer B28W08200
- H. Interior Drywall Paint - Egg-Shell/Flat
  - 1. Promar 200 Zero VOC B30W02651
- I. Interior Drywall Paint - Gloss
  - 1. Promar 200 Gloss B21W00251
- J. Interior Pipe Identification
  - 1. Hydro Gloss H20 Based Urethane B65W181
- K. Interior Galvanized Repair Paint
  - 1. ZRC Zero VOC Water Based Galvanizing Compound
- L. Interior Concrete Sealed Finish
  - 1. Manufactured by W.R. Meadows

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## 2. Bellatrix series

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  1. Concrete: 12 percent.
  2. Masonry (Clay and CMU): 12 percent.
  3. Wood: 15 percent.
  4. Gypsum Board: 12 percent.
  5. Plaster: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

#### 3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
  2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- H. Wood Substrates:
  1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  2. Sand surfaces that will be exposed to view, and dust off.
  3. Prime edges, ends, faces, undersides, and backsides of wood.
  4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

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- I. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

### 3.03 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
  1. Use applicators and techniques suited for paint and substrate indicated.
  2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
  1. Mechanical Work:
    - a. Uninsulated metal piping.
    - b. Pipe hangers and supports.
    - c. Tanks that do not have factory-applied final finishes.
    - d. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
    - e. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - f. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
  2. Electrical Work:
    - a. Electrical equipment that is indicated to have a factory-primed finish for field painting.

### 3.04 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.05 INTERIOR PAINTING SCHEDULE

- A. Toilet Rooms:
  1. Industrial Low-Odor/VOC System:
    - a. Walls and Ceilings: One full coat primer and two full coat gloss finish.
    - b. Accents: One full coat primer and two full coat high-gloss finish.
- B. Offices:
  1. Low-Odor/VOC System:

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- a. Walls and Ceilings: One full coat primer and two full coat eggshell finish.
  - b. Accents: One full coat primer and two full coat eggshell finish.
  - c. Ceilings: One full coat primer and two full coat flat finish.
  - d. Doors and Frames: One full coat primer and two full coat gloss finish.
- C. Concrete Substrates, Traffic Surfaces:
  - 1. Water-Based Clear Sealer System:
    - a. First Coat: Interior/exterior clear concrete floor sealer (water based).
    - b. Topcoat: Interior/exterior clear concrete floor sealer (water based).
- D. CMU Substrates:
  - 1. Institutional Low-Odor/VOC Latex System: MPI INT 4.2E.
    - a. Prime Coat: Interior/exterior latex block filler.
    - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
    - c. Topcoat: Institutional low-odor/VOC interior latex (eggshell) .
- E. Steel Substrate (Refer to 099600 where High Performance Coatings are indicated):
  - 1. Institutional Low-Odor/VOC Latex System: MPI INT 5.1S.
    - a. Prime Coat: Rust-inhibitive primer (water based).
    - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
    - c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).
- F. Galvanized-Metal Substrates:
  - 1. Latex Over Waterborne Primer System: MPI INT 5.3J.
    - a. Prime Coat: Waterborne galvanized-metal primer.
    - b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex (semigloss).
- G. Aluminum (Not Anodized or Otherwise Coated) Substrates:
  - 1. Latex System:
    - a. Prime Coat: Quick-drying primer for aluminum.
    - b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex (semigloss).
- H. Gypsum Board Substrates:
  - 1. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.
    - a. Prime Coat: Interior latex primer/sealer.
    - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
    - c. Topcoat: Institutional low-odor/VOC interior latex (eggshell) .

**END OF SECTION 099123 09 9123**

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## SECTION 09 9600 HIGH-PERFORMANCE COATINGS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. High performance coatings.
- B. Surface preparation.

#### 1.02 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.
- C. SSPC-SP 1 - Solvent Cleaning.
- D. SSPC-SP 2 - Hand Tool Cleaning.
- E. SSPC-SP 3 - Power Tool Cleaning.
- F. SSPC-SP 7 - Brush-Off Blast Cleaning.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Submittals, for submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
  - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
  - 2. Cross-reference to specified coating system(s) product is to be used in; include description of each system.
  - 3. Manufacturer's installation instructions.
- C. Samples: Submit two samples 8 by 8 inch in size illustrating colors available for selection.
- D. Manufacturer's Certificate: Certify that high-performance coatings comply with VOC limits specified.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include cleaning procedures and repair and patching techniques.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of Projects.
  - 1. Extra Coating Materials: 2 gallon of each type and color.
  - 2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

#### 1.04 CLOSEOUT SUBMITTALS:

- A. Warranty Documentation: Submit copies of written warranty, as signed by the applicator, agreeing to repair or replace defective coating Work during the warranty period.

#### 1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the Work of this section approved by manufacturer.
- B. Certifications: Provide services of manufacturer's representative to certify that surface preparation and primer have been applied in accordance with the requirements of this Section.
  - 1. Certify dry-film thicknesses of applied coatings.
- C. Field Samples: Prior to installation Work, prepare sample panel as required to secure the Architect's acceptance prior to ordering materials. Upon acceptance of the Architect, sample panel may be an actual portion of the application required for this Work.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

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- B. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Coating 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.

#### **1.07 FIELD CONDITIONS**

- A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the coating product manufacturer.
- C. Restrict traffic from area where coating is being applied or is curing.

#### **1.08 WARRANTY**

- A. Correct defective Work, warranty period shall be 2 years commencing on date of Acceptance of Completion by the Owner.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Provide high performance coating products from the same manufacturer.
  - 1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
- B. High-Performance Coatings:
  - 1. Tnemec Company, Inc: [www.tnemec.com](http://www.tnemec.com).
  - 2. Substitutions: Section 01 6000 - Product Requirements.

#### **2.02 HIGH-PERFORMANCE COATINGS**

- A. Provide coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified:
  - 1. Lead Content: None.
  - 2. Scrubbability: Excellent.
  - 3. Gloss and Color Retention: Excellent
- B. Legend: The number code in each System reference indicates the manufacturer number of the products specified. The letter code in each System reference indicates the type of substrate material. Primers and finish coats shall be the products of a single manufacturer.

#### **2.03 TOP COAT MATERIALS**

- A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include filler coat.
- B. Type A Substrates (Applied over Standard Shop Primer):
  - 1. System A-1:
    - a. Field Primer: Tnemec Series 135 Chembuild two-part catalyzed epoxy coating.
    - b. Finish: Tnemec Endura-Shield II Series 1075 acrylic polyurethane enamel.
  - 2. System A-3: Equivalent product by Carboline for application.
- C. Type B Substrates (Applied Over Ferrous Metals):
  - 1. System B-1:
    - a. Primer: Tnemec Series 90-97 Tneme-Zinc (shop-applied) two-part moisture-cured zinc-rich urethane coating.
    - b. Spot Prime (field-applied, if required): Tnemec Series 94 H20 Hydro-Zinc two-part moisture-cured zinc-rich urethane coating.
    - c. Intermediate Coat: Tnemec Hi-Build Epoxoline II Series L69 twopart catalyzed epoxy.

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- d. Solid Color Finish Coat: Tnemec Endura-Shield II Series 1080 waterborne polyurethane coating.
  - e. Clear Coat: Tnemec Series 750UVX.
- D. Type C Substrates (Applied Over Galvanized or Aluminum Materials):
  - 1. System C-1:
    - a. Primer: Tnemec Hi-Build Epoxoline II Series L69 (field-applied) two-part catalyzed epoxy coating.
    - b. Finish: Tnemec Endura-Shield II Series 1075 aliphatic acrylic polyurethane enamel.
      - 1) Where eggshell finish is specified, provide Tnemec Endura-Shield Series 175 aliphatic acrylic polyurethane enamel.
- E. Sheen: Provide semi-gloss finish.
- F. Colors: Custom, colors to match to be provided by Architect.
- G. Primer Number of Coats: Two
- H. Finish Number of Coats: One
- I. Dry Film Thickness: Minimum 16 mils total system.

## **2.04 PRIMERS**

- A. Primers: Provide the following unless other primer is required or recommended by coating manufacturer.

## **2.05 ACCESSORY MATERIALS**

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting Work.
- B. Do not begin application of coatings until substrates have been properly prepared.
- C. Verify that substrate surfaces are ready to receive Work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.
- D. Examine surfaces scheduled to be finished prior to commencement of Work. Report any condition that may potentially affect proper application.
- E. Test shop-applied primer for compatibility with subsequent cover materials.

### **3.02 PREPARATION**

- A. Clean surfaces of loose foreign matter.
- B. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.
- C. Remove finish hardware, fixture covers, and accessories and store.
- D. Galvanized Surfaces:
  - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
  - 2. Prepare surface according to SSPC-SP 3.
- E. Ferrous Metal:
  - 1. Solvent clean according to SSPC-SP 1.
  - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
  - 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 7 "Brush-Off Blast Cleaning", and protect from corrosion until coated.

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- F. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

### **3.03 PRIMING**

- A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

### **3.04 COATING APPLICATION**

- A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified.
- B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.
  - 1. Sags, checks, blisters, skips, teardrops, or rolled edges shall not be accepted and shall be completely removed and recoated.

### **3.05 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.
- B. Dry Film Thickness Testing: Owner will engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
  - 1. Touch up and restore coated surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, and specified thickness, Contractor shall pay for retesting and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations, and specified thickness.

### **3.06 CLEANING**

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Clean surfaces immediately of overspray, splatter, and excess material.
- C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

### **3.07 PROTECTION**

- A. Protect finished Work from damage.

**END OF SECTION 09 9600**

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## SECTION 10 1400 SIGNAGE

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Room and door signs.
- B. Building identification signs.

#### 1.02 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.
- B. ICC A117.1 - Accessible and Usable Buildings and Facilities.
- C. CBC Section 11B Division 7.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for 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; upon request, submit preliminary schedule.
  - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.

#### 1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Signage and graphics: CBC Section 11B-703
  - 1. Depth: It shall be 1/32 inch minimum above their background and shall be sans serif uppercase and be duplicated in Braille.
  - 2. Height: It shall be 5/8 inch minimum and 2 inches maximum based on the height of the uppercase letter "I". CBC Section 11B-703.2.5
  - 3. Finish and Contrast: Characters and their background shall have a non-glare finish. Character shall contrast with their background with either light characters on a dark background, or dark characters on a light background. CBC Section 11B-703.5.1
  - 4. Proportions: It shall be selected from fonts where the height of the uppercase letter "O" is 60% minimum and 110% maximum of the height of the uppercase letter "I". Stroke thickness of the uppercase letter "I" shall be 15% maximum of the height of the character. CBC Section 11B-703.4 and 11B-703.6
  - 5. Character Spacing: Spacing between individual tactile characters shall comply with CBC Section 11B-703.2.7 and 11B-703.2.8
  - 6. Braille: It shall be contracted (Grade 2) and shall comply with CBC Sections 11B-703.3 and 11B-703.4. Braille dots shall have a domed and rounded shape and shall comply with CBC Table and Figure 11B-703.3.1.
  - 7. Mounting Location: a tactile sign shall be located on the approach side, as one enters or exits rooms or space, and be reached within 0 inches of the required clear floor space per CBC Section and Figure 11B-703.4.2 as follows:

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- a. A clear floor space of 18 x 18 inches minimum, centered on the tactile characters, shall be provided beyond the arc of any door swings between the closed position and 45 degree open position.
  - b. On the wall at the latch side of a single door.
  - c. On the inactive leaf of a double door with one active leaf.
  - d. On the wall at the right side of a double door with two active leaves.
  - e. On the nearest adjacent wall where there is no wall space at the latch side of a single door or no space at the right side of a double door with two active leaves.
8. Symbol of accessibility shall comply with CBC Section 11B-703.7.

## **1.05 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.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Flat Signs:
  1. Mohawk Sign Systems, Inc: [www.mohawksign.com/#sle](http://www.mohawksign.com/#sle).
  2. Roemer Industries.
  3. ASI Modulex
- B. Dimensional Letter Signs:
  1. Matthews International Corporation.
  2. Gemini Inc..

### **2.02 SIGNAGE APPLICATIONS**

- A. 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.
- B. Building Identification Signs:
  1. Use individual metal letters.
  2. Mount on outside wall in location indicated on drawings.
- C. Other Dimensional Letter Signs: Wall-mounted.
  1. Exterior: As indicated in drawings.

### **2.03 SIGN TYPES**

- A. Flat Signs: Signage media without frame.
  1. Edges: Square.
  2. Corners: Square.
  3. Wall Mounting of One-Sided Signs: Concealed or exposed screws.
- B. Color and Font: Unless otherwise indicated:
  1. Character Font: Helvetica, Arial, or other sans serif font.
  2. Character Case: Upper case only.
  3. Background Color: Clear.
  4. Character Color: Contrasting color.

### **2.04 TACTILE SIGNAGE MEDIA**

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
  1. Thickness: As indicated in drawings.
  2. Fasteners: Stainless steel screws, pin torx, vandal proof.

### **2.05 NON-TACTILE SIGNAGE MEDIA**

- A. Sand Blasted Plastic Panels: High gloss acrylic plastic; letters sand blasted to dull sheen:
  1. Total Thickness: 1/4 inch.
  2. Fasteners: Stainless steel screws, pin torx, vandal proof.

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## **2.06 DIMENSIONAL LETTERS**

- A. Metal Letters:
  - 1. Metal: Aluminum sheet, flat.
  - 2. Metal Thickness: 1/16 inch minimum.
  - 3. Letter Height: As indicated on drawings.
  - 4. Finish: Brushed, satin.
  - 5. Mounting: Concealed or exposed screws. Stainless steel.

## **2.07 ACCESSORIES**

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Exposed Screws: Stainless steel.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work.

### **3.02 INSTALLATION**

- A. Install neatly, with horizontal edges level.
- B. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- C. Protect from damage until Substantial Completion; repair or replace damaged items.

**END OF SECTION 10 1400**

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## SECTION 10 2113.17 PHENOLIC TOILET COMPARTMENTS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Phenolic toilet compartments.
- B. Urinal screens.

#### 1.02 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for 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, 6 by 6 inch in size illustrating panel finish, color, and sheen.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Phenolic Toilet Compartments:
  - 1. Partition Systems International of South Carolina: [www.psisc.com/#sle](http://www.psisc.com/#sle).
  - 2. Bobrick Washroom Equipment.
  - 3. Comtec, Capitol
  - 4. Weis/Robart Partitions
  - 5. Accurate Partitions - BASIS OF DESIGN Color Thru series

#### 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-mounted headrail-braced.
  - 1. Color: As indicated on drawings.
- B. Doors:
  - 1. Thickness: 3/4 inch.
- C. Panels:
  - 1. Thickness: 1/2 inch.
  - 2. Depth: As indicated on drawings.
- D. Pilasters:
  - 1. Thickness: 3/4 inch.
  - 2. Width: As required to fit space; minimum 6 inch.
- E. Screens: Without doors; to match compartments; mounted to wall with 3 panel brackets with vertical support/bracing same as compartments.
- F. Class A: Flame spread 0-25 and Smoke Development 0-450

#### 2.03 ACCESSORIES

- A. Pilaster Shoes: Formed ASTM A666 Type 304 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings.
  - 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

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- B. Head Rails: Hollow anodized aluminum, 1 inch by 1-1/2 inch size, with anti-grip profile and cast socket wall brackets.
- C. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
- D. Hardware: Polished stainless steel:
  - 1. Pivot hinges, gravity type, adjustable for door close positioning; two per door. At accessible and ambulatory compartments to be self-closing.
  - 2. Door Latch: Slide type with exterior emergency access feature.
  - 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.
  - 5. Provide door pull for outswinging doors. At accessible and ambulatory compartments to have door pull in both sides of the doors, mount 34"-44" above floor.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated on shop drawings.
- 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 1/4" inch to 3/8 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. 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: 1/8 inch.
- B. Maximum Variation From Plumb: 1/16 inch.

#### **3.04 ADJUSTING**

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- 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 10 2113.17**

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## SECTION 10 2800 TOILET, BATH, AND LAUNDRY ACCESSORIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Under-lavatory pipe supply covers.
- C. Diaper changing stations.
- D. Utility room accessories.

#### 1.02 REFERENCE STANDARDS

- A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- D. ASTM B86 - Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings.
- E. ASTM C1036 - Standard Specification for Flat Glass.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
- G. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use.
- H. CBC 1118B - Space Allowance and Reach Ranges; California Building Code.

#### 1.03 QUALITY ASSURANCE

- A. Sanitary Facility Elements: CBC Section 11B-602 through 11B-612
  - 1. Elements of sanitary facilities shall be mounted at locations in compliance with CBC Sections 11B-602 through 11B-612.
  - 2. Grab bars on toilet facilities and bathing facilities shall comply with CBC Section 11B-609. Grab bars and any wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive elements and shall have rounded edges. The space around the grab bars shall be as follows:
    - a. 1-1/2 inches between the grab bar and the wall.
    - b. 1-1/2 inches minimum between the grab bar and projecting objects below and at the ends.
    - c. 12 inches minimum between the grab bar and projecting objects above.
  - 3. Toilet paper dispensers shall be continuous flow type.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Commercial Toilet, Shower, and Bath Accessories:
  - 1. As indicated on drawings.
- B. Under-Lavatory Pipe Supply Covers:
  - 1. Plumberex Specialty Products, Inc: [www.plumberex.com/#sle](http://www.plumberex.com/#sle).
- C. Diaper Changing Stations:
  - 1. As indicated on drawings.

#### 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.

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- B. Keys: Provide 3 keys for each accessory to Owner; master key lockable accessories.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- F. Zinc Alloy: Die cast, ASTM B86.
- G. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.
- H. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

### **2.03 FINISHES**

- A. Stainless Steel: Satin finish, unless otherwise noted.

### **2.04 UNDER-LAVATORY PIPE AND SUPPLY COVERS**

- A. Under-Lavatory Pipe and Supply Covers:
  - 1. Insulate exposed drainage piping including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
  - 2. Color: White.

### **2.05 DIAPER CHANGING STATIONS**

- A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
  - 1. Material: Polyethylene.
  - 2. Mounting: Surface.
  - 3. Minimum Rated Load: 250 pounds.

### **2.06 UTILITY ROOM ACCESSORIES**

- A. Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, hat-shaped channel.
  - 1. Holders: Three spring-loaded rubber cam holders.
  - 2. Length: Manufacturer's standard length for number of holders.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.

### **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.

### **3.04 PROTECTION**

- A. Protect installed accessories from damage due to subsequent construction operations.

**END OF SECTION 10 2800**

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## SECTION 10 4400 FIRE PROTECTION SPECIALTIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

#### 1.02 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
- B. FM (AG) - FM Approval Guide.
- C. NFPA 10 - Standard for Portable Fire Extinguishers.
- D. UL (DIR) - Online Certifications Directory.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, anchorage details, and installation instructions.
- C. Shop Drawings: Indicate locations of cabinets, cabinet physical dimensions, rough-in measurements for recessed cabinets, locations of individual fire extinguishers, and accessories required for complete installation.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

#### 1.04 QUALITY ASSURANCE

- A. Fire extinguisher cabinets must comply with CBC Sections 11B-307, 11B-308, 11B-309 and 11B-403.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Fire Extinguishers:
  - 1. Larsen's Manufacturing Co; : [www.larsensmfg.com](http://www.larsensmfg.com).
  - 2. Potter-Roemer; : [www.potterroemer.com](http://www.potterroemer.com).
  - 3. Amerex Corp..
- B. Fire Extinguisher Cabinets and Accessories:
  - 1. Larsen's Manufacturing Co: [www.larsensmfg.com](http://www.larsensmfg.com).
  - 2. BASIS of DESIGN: Potter-Roemer: [www.potterroemer.com](http://www.potterroemer.com).
  - 3. Amerex Corp..
  - 4. Substitutions: See Section 01 6000 - 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. Finish: Baked polyester powder coat, red color.
  - 3. Temperature range: Minus 40 degrees F to 120 degrees F.

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4. Type by Location:
  - a. UL-rated 3-A:40-B:C, 5-lb. All Classrooms, Multipurpose rooms, Library, Administration, Locker rooms and where indicated on drawings.
  - b. UL-rated 4-A:80-B:C, 10-lb. Equipment rooms, Laboratory classrooms, Sciences classrooms, Storage rooms, Shoppes, Stage and where indicated on drawings.

### 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. Fire Rated Cabinet Construction: One-hour fire rated.
  1. Steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
- C. Construction: Non-rated at Surface Mounted type.
- D. Cabinet Configuration: Surface mounted type.
  1. Size to accommodate accessories.
  2. Trim: Flat square edge, with 1 inch wide face.
  3. Projected Trim: Returned to wall surface, with 4 maximum inch projection, and 2 inch wide face.
- E. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with lock and breakable window access. Hinge doors for 180 degree opening with two butt hinge.
- F. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- G. Finish of Cabinet Exterior Trim and Door: Baked enamel, white color.
- H. Finish of Cabinet Interior: White colored enamel.
- I. Fire-Rated Cabinets: Double walls fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick, fire-barrier material; factory-drilled mounting holes.

### 2.04 ACCESSORIES

- A. Cabinet Signage: "FIRE EXTINGUISHER".
  1. Location: Applied to cabinet door.
  2. Application Process: Silk-screened.
  3. Lettering Color: Red
  4. Orientation: Vertical
- B. Keys to Door Locks: one per lock.

## 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 level, position as detailed, where handle / operable parts are 48 inches maximum above finish floor..
- C. Place extinguishers in cabinets.

**END OF SECTION 10 4400**

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## SECTION 10 5129 PHENOLIC LOCKERS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Phenolic lockers.
- B. Locker benches.

#### 1.02 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes and accessories.
- C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.
- D. Samples: Submit two samples 3 by 6 inches in size, of each color scheduled.

#### 1.04 QUALITY ASSURANCE

- A. Lockers: CBC Sections 11B-225.2.1
  - 1. At least 5%, but no fewer than one of each type of lockers shall comply with CBC Section 11B-811.

#### 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. Columbia Lockers, a division of PSiSC: [www.psisc.com/#sle](http://www.psisc.com/#sle).
  - 2. Substitutions: See Section 01 6000 - Product Requirements.

#### 2.02 LOCKER APPLICATIONS

- A. Athletic Lockers: Single tier lockers, free-standing for base indicated on drawings.
  - 1. Width: 12 inches.
  - 2. Depth: 12 inches.
  - 3. Height: 16 inches.
  - 4. Fittings: Size and configuration as indicated on drawings.
  - 5. Locking: Built-in key locks with spring bolt action.

#### 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 minimum thickness.

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2. Locker Body: One of the following combinations:
  - a. Tops, bottoms, and shelves 3/8 inch; sides and backs 5/16 inch; minimum.
  - b. Tops, bottoms, and shelves 1/2 inch; sides 3/8 inch; backs 1/4 inch; minimum.
3. End Panels and Filler Panels: 1/2 inch minimum thickness.
4. Sloped Tops: 1/2 inch 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. Hinges: Stainless steel, satin finish; minimum of 180 degree opening; either exposed barrel 5-knuckle hinge attached to back of door and inside of body with tamperproof screws, or concealed cabinet style hinge attached with tamperproof screws.
- E. Number Plates: Manufacturer's standard, minimum 4-digit, permanently attached with adhesive; may be field installed.
- F. Lock Strike: Stainless steel, or black high impact ABS plastic strike plate attached to locker body with throughbolts.
- G. Built-In Lock Boxes: Same material as locker, manufacturer's standard size, with padlock hasps, for padlocks provided by Owner.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that prepared bases are in correct position and configuration.

#### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install lockers plumb and square.
- C. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.
- D. Install end panels, filler panels, and sloped tops.
- E. Replace components that do not operate smoothly.

#### **3.03 CLEANING**

- A. Clean locker interiors and exterior surfaces.

**END OF SECTION 10 5129**

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## SECTION 13 1100

### SWIMMING POOL GENERAL REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. The scope of the work included under this Section of the Specifications shall include swimming pool(s) as illustrated on the Drawings and specified herein. The General and Supplementary Conditions of the Specifications shall form a part and be included under this Section of the Specifications. The Swimming Pool Subcontractor shall provide all supervision, labor, material, equipment, machinery, plant and any and all other items necessary to complete the work. ALL OF THE WORK IN SECTIONS 13 1100 – 13 1108 IS TO BE THE RESPONSIBILITY OF ONE EXPERIENCED SWIMMING POOL SUBCONTRACTOR PRIMARILY ENGAGED IN THE CONSTRUCTION OF COMMERCIAL PUBLIC-USE SWIMMING POOLS. A SWIMMING POOL SUBCONTRACTOR SHALL BE CONSIDERED PRIMARILY ENGAGED AS REQUIRED HEREIN IF THE SUBCONTRACTOR DERIVED 50% OF ITS ANNUAL REVENUE FROM PUBLIC-USE SWIMMING POOL CONSTRUCTION FOR EACH OF THE LAST FIVE YEARS. THE SUBCONTRACTOR MUST HAVE ALSO, IN THE LAST FIVE YEARS CONSTRUCTED AT LEAST FIVE (5) COMMERCIALY DESIGNED MUNICIPAL AND PUBLIC-USE SWIMMING POOLS, EACH OF WHICH SHALL HAVE INCORPORATED A MINIMUM SIZE OF 6,000 SQUARE FEET OF WATER SURFACE AREA WITH A CONCRETE AND CERAMIC TILE PERIMETER OVERFLOW GUTTER AND SELF-MODULATING BALANCE TANK. The Swimming Pool Subcontractor shall furnish and install the swimming pool structures, finishes, cantilever forming, swimming pool mechanical and electrical systems, and all accessories necessary for a complete, functional swimming pool system, as herein described. Work shall include start-up, instruction of Owner's personnel, as-built drawings and warranties as required.

##### 1.02 CODES, RULES, PERMITS, FEES

- A. The swimming pools shall be constructed in strict accordance with the applicable provisions set forth by authorities having jurisdiction over swimming pool construction and operation in the State of California.
- B. The Swimming Pool Subcontractor shall give all necessary notices, obtain all permits, and pay all government sales taxes, fees, and other costs in connection with their work; file all necessary plans, prepare all documents and obtain all necessary approvals of governmental departments having jurisdiction; obtain all required certificates of inspection for their work and deliver same to the Designated Representative before request for acceptance and final payment for the work.
- C. The Swimming Pool Subcontractor shall include in the work any labor, materials, services, apparatus, or drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on Drawings and/or specified.
- D. The Contractor shall submit all required documents and materials to all Governmental Departments having jurisdiction for any deferred approval items or substituted materials or products to obtain final approval to installation.

##### 1.03 DESCRIPTION OF WORK

- A. Furnish and perform supervision, coordination, all layout, formwork, excavation, hand trim, disposing off-site of all unused material or debris to complete the swimming pool excavation to the dimensions shown on the plans.
- B. Furnish and install complete swimming pool structures, including reinforcing steel and cast-in-place or pneumatically placed concrete walls and floors.
- C. Furnish and install swimming pool finishes, including ceramic tile and marble plaster or other waterproof finishes.

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- D. Furnish and install complete swimming pool mechanical system(s), including, but not limited to, circulation systems, filtration systems, pool water heating systems, water chemistry control systems, domestic water fill line systems, booster pump and special effects systems, and all pumps, piping, valves, and connections between system(s) and swimming pool(s).
- E. Furnish and install complete swimming pool electrical system(s) from P.O.C. in Mechanical Room, including, but not limited to, underwater lighting systems, water level control systems, timing systems, scoreboards, special effects systems, control circuitry, motor starters, time clocks, bonding, and all conduits, conductors, contactors, and switches between the system(s) and swimming pool(s).
- F. Furnish and install all swimming pool cantilever forming, deck equipment and required anchors and inserts for the specified equipment as required by code, shown on the Drawings and specified herein.
- G. After the initial filling of the swimming pool system(s), should any repairs, continuing work, or other Subcontractor responsibility require drainage or partial drainage of the swimming pool systems, the Swimming Pool Subcontractor shall be responsible for any subsequent refilling and shall complete the project with the swimming pool system(s) full of water, water in chemical balance, complete in every way, and in full operation.

#### **1.04 ASSIGNED RESPONSIBILITIES AND RELATED WORK**

- A. It is the intent of this section of the Specifications to clarify Work responsibilities of the trades directly and indirectly involved in construction of the pool systems. All labor, equipment, materials and supplies furnished by the Swimming Pool Subcontractor and other Subcontractors per the contractual agreement with the General Contractor and Owner and shall be as directed by the Owner through their Designated Representative.
- B. THE SWIMMING POOL SUBCONTRACTOR SHALL NOT SUBCONTRACT ANY PORTION OF THE SWIMMING POOL CONSTRUCTION OR SWIMMING POOL EQUIPMENT INSTALLATION TO ANYONE OTHER THAN A SUBCONTRACTOR THAT SATISFIES THE REQUIREMENTS OF SECTION 13 1100.
- C. References to "swimming pool systems" shall include the swimming pools, equipment, and accessories.
- D. The Owner will provide one complete water filling of the swimming pool(s), but will not assume any responsibility for the swimming pool system(s) until they have been proved fully operational, complete in every way and accepted by the Designated Representative.

#### **1.05 RESPONSIBILITIES OF THE CONTRACTOR**

- A. The Contractor shall grade the swimming pool site(s), establish benchmarks, cut and fill as necessary to provide as level an area as possible at swimming pool deck elevation before swimming pool layout.
- B. The Contractor shall be responsible for horizontal dimensions and grade elevations accurately from established lines and benchmarks (as indicated on the Drawings) and be responsible for those grades.
- C. The Contractor shall provide adequate temporary light, electric power, heat and ventilation per Federal and State OSHA requirements to construct the swimming pool system(s).
- D. The Contractor shall not permit any heavy equipment activity over any area or within five (5) feet of any area under which swimming pool piping is buried. There shall be no exceptions to this requirement.
- E. The Contractor shall keep the swimming pool excavation(s) and swimming pool structure(s) free of construction residue and waste materials of their workmen or Subcontractors, removing said material from the swimming pools as required.
- F. The Contractor shall protect the swimming pool(s) from damage caused by their construction equipment and /or workmen and Subcontractors.

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- G. The Contractor shall provide a representative at time of swimming pool start-up to coordinate all trades related to swimming pool system(s).

#### **1.06 RESPONSIBILITIES OF THE MECHANICAL SUBCONTRACTOR**

- A. The Mechanical Subcontractor shall be licensed in the State of California and provide written notifications to Swimming Pool Subcontractor and contractor when necessary to excavate and backfill within the swimming pool construction site.
- B. The Mechanical Subcontractor shall not utilize any swimming pool piping trench for installation of any sanitary sewer, storm sewer, domestic water, hot water, chilled water or natural gas line.
- C. The Mechanical Subcontractor shall furnish and install all sanitary sewer piping, including vent stacks (if necessary), for backwash pits, floor drains and floor sinks as required by code, shown on Drawings, and herein specified.
- D. The Mechanical Subcontractor shall furnish and install all storm sewer piping and site drainage systems as required by code, shown on the Drawings, and herein specified.
- E. The Mechanical Subcontractor shall provide a minimum 75 psi water supply for swimming pool construction work within fifty (50) feet of the swimming pool construction site(s).
- F. The Mechanical Subcontractor shall furnish and install reduced pressure backflow protected domestic water lines to P.O.C. within swimming pool Mechanical Room as required by code, shown on the Drawings, and herein specified.
- G. The Mechanical Subcontractor shall furnish and install natural gas piping, pressure regulation and valving to P.O.C. within swimming pool Mechanical Room as required by code, shown on the drawings, and herein specified.
- H. The Mechanical Subcontractor shall furnish and install all ductwork, louvers, and all HVAC equipment within swimming pool Mechanical Room as required by code, shown on the Drawings, and herein specified.
- I. The Mechanical Subcontractor shall provide a representative at time of swimming pool start-up to coordinate work related to swimming pool system(s).

#### **1.07 RESPONSIBILITIES OF THE ELECTRICAL SUBCONTRACTOR**

- A. The Electrical Subcontractor shall be licensed in the State of California and shall furnish and install electrical service to swimming pool Mechanical Room sized to accommodate all necessary swimming pool equipment as shown on the Drawings and herein specified.
- B. The Electrical Subcontractor shall furnish any temporary power needed by the Swimming Pool Subcontractor within fifty (50) feet of the swimming pool construction site(s).
- C. The Electrical Subcontractor shall furnish and install all conduits, conductors, starters/disconnects, panels, circuits, switches and equipment as required for lighting, ventilation and HVAC equipment within swimming pool Mechanical Room as required by code, shown on the Drawings, and herein specified.
- D. The Electrical Subcontractor shall furnish and install all conduits, conductors, panels, circuits, switches and equipment for area lighting as required by code, shown on the Drawings, and herein specified.
- E. All equipment, material and installation shall be as required under Division 16 of the Specifications and shall conform to CEC Article 680 (latest revision), State and Local Codes, and as may be required by all authorities having jurisdiction over swimming pool construction within the State of California.
- F. The Electrical Subcontractor shall provide a representative at time of swimming pool start-up to coordinate work related to swimming pool system(s).

#### **1.08 INTENT**

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- A. It is the intention of these specifications and Drawings to call for finished work, tested and ready for operation. Wherever the work "provide" is used, it shall mean "furnish and install complete and ready for use."
- B. Minor details not usually shown or specified, but necessary for proper installation and operation, shall be included in the work, the same as if herein specified or shown.

#### 1.09 SCHEDULE OF VALUES

- A. Provide a Schedule of Values for all work specified in each of the technical specifications listed in the table below, regardless of whether the work is performed by the swimming pool contractor or others. Values listed shall be fully burdened, with contractor general conditions, overhead, profit and bonds included. Payments for swimming pool work completed shall not be approved until Schedule of Values has been submitted to and approved by Architect.

B.

SWIMMING POOL SCHEDULE OF VALUES			
No.	Section #	Description	Value
1.	13 1101	Swimming Pool Excavation	
2.	13 1102	Swimming Pool Concrete	
3.	13 1103	Swimming Pool Shotcrete	
4.	13 1104	Swimming Pool Ceramic Tile	
5.	13 1105	Swimming Pool Plaster	
6.	13 1106	Swimming Pool Equipment	
7.	13 1107	Swimming Pool Mechanical	
8.	13 1108	Swimming Pool Electrical	
Total			

#### 1.10 SUBMITTAL PROCEDURES

- A. General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Architect for Subcontractor's use in preparing submittals.
- B. Coordination: Coordinate preparation and processing submittals with performance construction activities.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for schedules performance of related construction activities.
- D. Processing Time: Allow enough time for submittal review, including time for re-submittals as follows. Time for review shall commence on Architect's receipt of submittal.
  - 1. Initial Review: Allow fifteen (15) days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contract when a submittal being processed must be delayed for coordination.
  - 2. Concurrent Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow twenty-one (21) days for initial review of each submittal.

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3. Direct Transmittal to Consultant: Where the Contract Documents indicate that submittals may be transmitted directly to Architect's consultants, provide duplicate copy of transmittal to Architect. Submittal will be returned to Architect before being returned to Subcontractor.
  4. If intermediate submittal is necessary, process it in same manner as initial submittal.
  5. Allow fifteen (15) days for processing each submittal.
  6. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.
- E. Identification: Place a title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on title block.
  2. Provide a space on title block to record Subcontractor's review and approval markings and action take by Architect.
  3. Include the following information on title block for processing and recording action taken: (See Attached Sample)
    - a. Project name.
    - b. Date.
    - c. Name and address of Subcontractor.
    - d. Name of Subcontractor.
    - e. Name of Supplier.
    - f. Name of Manufacturer.
    - g. Unique identifier, including revision number.
    - h. Number and title of appropriate Specification Section.
    - i. Drawing number and detail references, as appropriate.
    - j. Other necessary identification.

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SUBMITTAL FOR:	SUBMITTAL TO:	SUBCONTRACTOR:
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Item Number:	
Section Number:	
Section Description:	
Subcontractor:	
Supplier:	
Manufacturer:	
Product Code:	
Quantity:	

<p style="text-align: center;">Subcontractor Certification:</p> <p>It is hereby certified that the equipment or material designated in this submittal is proposed to be incorporated in the above-named project and is in compliance with the contract drawings and / or specifications and is submitted for approval.</p> <p>Certified by: _____</p> <p>Date: _____</p> <p>Job _____</p> <p>Superintendent: _____</p> <p>Revisions: _____</p>	<p style="text-align: center;">Contractor's Submittal Stamp:</p>
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Architect's Review Stamp and Comments
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- F. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract documents on submittal.
- G. On all catalogue or cut sheets identify which model or type is being submitted.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Product data and shop drawings shall be packaged within a three ring binder and colored samples shall be packaged on a heavy cardboard. Transmit each submittal using a transmittal form.
  - 1. On an attached separate sheet, prepared on Subcontractor's letterhead, record relevant information, request for data, revisions other than those requested by Architect on previous submittals and deviations from requirements of the Contract documents, including minor variations and limitations. Include the same label information as the related submittal.
  - 2. Include Subcontractor's certification stating that information submitted complies with requires of the Contract Documents.
  - 3. Transmittal Form: Provide locations on form for the following information:
    - a. Project name.
    - b. Date.
    - c. Destination (To:).
    - d. Source (From:).
    - e. Names of Subcontractor, manufacturer, and supplier.
    - f. Category and type of submittal.
    - g. Submittal purpose and description.
    - h. Remarks.
- I. Distribution: Furnish copies of final submittals to manufacturers, Subcontractors, suppliers, fabricators, installers, authorities having jurisdiction and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Use only final submittals with mark indicating action taken by Architect in connection with construction.

#### **1.11 SUBSTITUTIONS**

- A. To obtain approval to use unspecified products, bidders shall submit requests for substitution at least ten (10) days prior to bid date. Requests shall only be considered if they clearly describe the product for which approval is asked, including all data necessary to demonstrate acceptability. All unspecified products and equipment will be considered on an "or equal" basis at the discretion of the Designated Representative. Requests for substitution received after the specified deadline will not be considered. Where a conflict exists between the requirements of the General Conditions / Special Conditions / Division 1 concerning substitutions and the requirements of this Article, this Article (Section 13 1100, Article 1.10) shall govern.
- B. Where the Swimming Pool Subcontractor proposes to use an item of equipment other than that specified or detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring, or any other part of the architectural, mechanical, or electrical layout, all such redesign and all new drawings (stamped by California Licensed Engineer) and detailing required shall be prepared by the Swimming Pool Subcontractor, at his own expense, submitted for review and approval by the Designated Representative prior to bid.
- C. Where such approved deviation requires a different quantity and arrangement of piping, supports and anchors, wiring, conduit, and equipment from that specified or indicated on the Drawings, the Swimming Pool Subcontractor shall furnish and install any such piping, structural supports, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system, at no additional cost to the Owner.

#### **1.12 SURVEYS AND MEASUREMENTS**

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- A. The Swimming Pool Subcontractor shall base all measurements, both horizontal and vertical, from benchmarks established by the Contractor. All work shall agree with these established lines and levels. The mechanical Drawings do not give exact details as to elevations of piping, exact locations, etc. and do not show all offsets, control lines, pilot lines and other installation details. Verify all measurements at site and check the correctness of same as related to the work.

### 1.13 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of the systems and work included in the Subcontractor. Drawings are not to be scaled. The architectural drawings and details shall be examined for exact dimensions. Where they are not definitely shown, this information shall be obtained from the Designated Representative.

### 1.14 SWIMMING POOL SUBCONTRACTOR

- A. The swimming pool construction work as herein described and specified in Division 13 of the Project Manual shall be the complete responsibility of a qualified and specifically licensed (C-53 license classification within the State of California) Swimming Pool Subcontractor with extensive experience in commercial public use swimming pool installations.
- B. The Contractor shall require the Swimming Pool Subcontractor to furnish to the Contractor performance and payment bonds in the amount of 100% of the Swimming Pool Subcontractor's bid written by a surety Company properly registered in the State of California and listed by the U.S. Treasury. The expense of the bond(s) is to be borne by the Subcontractor. The Contractor shall clearly specify the amount and requirements of the bond(s) in the Contractor's written or published request for subbids. The Contractor's written or published request for subbids shall also specify that the bond(s) expense is to be borne by the Subcontractor.
- C. Subcontractor certifies that it meets the qualifications and experience requirements established in Swimming Pool General Requirements, Section 131100, as follows:
1. Subcontractor has derived 50% of its annual revenue from public-use swimming pool construction for each of the last five (5) years.
  2. Subcontractor has, in the last five (5) years, constructed at least five (5) commercially designed municipal and public-use swimming pools, each of which have incorporated a minimum size of 6,000 square feet of water surface area with a concrete and ceramic tile perimeter overflow gutter and self-modulating balance tank.
  3. The following list of projects meet the requirements of section (b) above and the contact as reference by the Contractor, the Awarding Authority of their agent or designee.

- a. Owner: \_\_\_\_\_  
Scope of Project: \_\_\_\_\_  
Contact Person: \_\_\_\_\_  
Phone Number: \_\_\_\_\_  
Architect for Project: \_\_\_\_\_
- b. Owner: \_\_\_\_\_  
Scope of Project: \_\_\_\_\_  
Contact Person: \_\_\_\_\_  
Phone Number: \_\_\_\_\_  
Architect for Project: \_\_\_\_\_
- c. Owner: \_\_\_\_\_  
Scope of Project: \_\_\_\_\_  
Contact Person: \_\_\_\_\_

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Phone Number: \_\_\_\_\_  
Architect for Project: \_\_\_\_\_

d. Owner: \_\_\_\_\_  
Scope of Project: \_\_\_\_\_  
Contact Person: \_\_\_\_\_  
Phone Number: \_\_\_\_\_  
Architect for Project: \_\_\_\_\_

e. Owner: \_\_\_\_\_  
Scope of Project: \_\_\_\_\_  
Contact Person: \_\_\_\_\_  
Phone Number: \_\_\_\_\_  
Architect for Project: \_\_\_\_\_

- D. Swimming Pool Deck Subcontractor other than the swimming pool Subcontractor certifies that it meets the qualifications and experience requirements established in Swimming Pool General Requirements, Section 13 1100, as follows:
1. Subcontract has, in the last five (5) years, constructed at least five (5) commercially designed cantilevered pool decks over perimeter gutters, each of which have incorporated a minimum size of 6,000 square feet of water surface area of the swimming pool.
  2. The following list of projects meet the requirements of section (b) above and the contact as reference by the Contractor, the Awarding Authority of their agent or designee.

#### SWIMMING POOL DECK SUBCONTRACTOR

a. Owner: \_\_\_\_\_  
Scope of Project: \_\_\_\_\_  
Contact Person: \_\_\_\_\_  
Phone Number: \_\_\_\_\_  
Architect for Project: \_\_\_\_\_

b. Owner: \_\_\_\_\_  
Scope of Project: \_\_\_\_\_  
Contact Person: \_\_\_\_\_  
Phone Number: \_\_\_\_\_  
Architect for Project: \_\_\_\_\_

c. Owner: \_\_\_\_\_  
Scope of Project: \_\_\_\_\_  
Contact Person: \_\_\_\_\_  
Phone Number: \_\_\_\_\_  
Architect for Project: \_\_\_\_\_

d. Owner: \_\_\_\_\_  
Scope of Project: \_\_\_\_\_  
Contact Person: \_\_\_\_\_  
Phone Number: \_\_\_\_\_

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Architect for Project: \_\_\_\_\_

- e. Owner: \_\_\_\_\_
- Scope of Project: \_\_\_\_\_
- Contact Person: \_\_\_\_\_
- Phone Number: \_\_\_\_\_
- Architect for Project: \_\_\_\_\_

### 1.15 OPERATING INSTRUCTIONS

- A. The Swimming Pool Subcontractor shall determine from actual samples of pool water supplied by the Owner, the proper water management program necessary for maximum operating efficiency and comfort. The Swimming Pool Subcontractor shall provide the services of experienced personnel familiar with this type of pool system operation, in conformance with Section 13 1105 of the Specifications.

### 1.16 MAINTENANCE MANUALS

- A. The Swimming Pool Subcontractor shall provide six (6) bound sets for delivery to the Designated Representative of instructions for operating and maintaining all systems and equipment included in this Contract. Manufacturer's advertising literature or catalog pictures will not be acceptable for operating and maintenance instructions.
- B. Bound in ring binders shall be all parts lists, periodic maintenance instructions and troubleshooting guidelines for all pool equipment, including but not limited to filters, pumps, controllers, water chemistry control equipment, etc.

### 1.17 SECURE FROM THE OWNER

- A. A complete Owner-furnished filling of the swimming pools.
- B. The Owner's assistance, as specified herein, from the time of start-up until final written acceptance of the swimming pool system(s).
- C. Chemicals as required for swimming pool operation after Swimming Pool Subcontractor completes initial water chemistry balance and water treatment during the maintenance period described in Section 13 1105 of the Specifications.

### 1.18 WARRANTY

- A. The Swimming Pool Subcontractor shall warrant all swimming pool structures, finishes and systems against defects in material and workmanship for a period of one year after the date of acceptance by the Owner. Any repair or replacement required due to defective material or workmanship will be promptly corrected by the Swimming Pool Subcontractor.

### PART 2 PRODUCTS

Not Used

### PART 3 EXECUTION

Not Used

**END OF SECTION 13 1100**

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## SECTION 13 1101 SWIMMING POOL EXCAVATION

### PART 1 GENERAL

#### 1.01 DESCRIPTION

- A. Finish and fine grading to bring the surface of the ground to the required grades and elevations as indicated on the Drawings.
- B. Subgrade improvements and placing of compacted fills.
- C. Excavation and backfill for all swimming pool, surge chamber and structural requirements, including footings, foundations, slabs and walls.

#### 1.02 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: Conform with requirements of the General Conditions, and more specifically the following:
  - 1. Comply with California Building Code, latest edition.
  - 2. Comply with applicable construction safety orders, latest edition, Federal and State OSHA.
  - 3. Comply with applicable trench safety provisions, latest edition, Federal and State OSHA.
- B. Qualifications of Workers:
  - 1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
  - 2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years' experience with the materials and methods specified.
  - 3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years' experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.
- C. Project/Site Conditions:
  - 1. Be familiar with site and subsurface conditions.
  - 2. Excavation is unclassified and includes excavation to sub-grade elevations indicated or necessary, regardless of character of materials and obstructions encountered.
  - 3. Provisions for mitigation of wet soils due to seepage or rain shall be made during excavation and throughout construction. If wet soils are encountered within the swimming pool excavations, de-watering shall be provided and the Geotechnical Engineer shall make recommendations for moist soil mitigation.
  - 4. Where slope instability is encountered, all excavations within those areas shall be 2:1 or flatter. Forming of vertical walls may be necessary, and all soil conditions shall be field verified by the Geotechnical Engineer.
  - 5. Contractor shall review the Geotechnical Investigation Report as furnished by the Owner to determine the suitability of the soils.
- D. Adverse Weather Conditions:
  - 1. During the periods when site soil moisture content is substantially in excess of moisture content required for optimum compaction, do not perform fill compaction.
  - 2. When unfavorable weather conditions necessitate interrupting filling and grading operations, prepare areas by compaction of surface and grading to avoid collection of water. Provide adequate temporary drainage to prevent erosion.

#### 1.03 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in conformance with requirements of Section 01 3300.
- B. Required submittals include:

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1. Offsite fill material, if applicable.

C. Submit proof of qualifications as specified in Article 1.02.B of this Section.

#### **1.04 EXCAVATING & TRENCHING, GENERAL REQUIREMENTS**

- A. All trenches, holes, etc. are to be completely protected using solid barricades, steel plates, and plywood both during construction and during off hours, including night time.
- B. Flashing warning light barricades are required on sidewalks, roads, and any other critical areas that require night time protection.
- C. Roads, paths and sidewalks shall not be blocked at any time or in any way. Trenching across roads, paths or sidewalks involves special instructions and review of the construction procedure by the Owner at least three (3) days prior to the Work actually being started.
- D. Construction equipment, including all trucks, cars, etc. shall not be parked or driven on roads, paths or sidewalks. Items not allowed on roads, paths or sidewalks include hoses, power cords, ropes, construction materials, dirt and debris, etc.
- E. All roads, paths and sidewalks must remain clear and the Contractor shall maintain temporary safe and effective pedestrian access at all times.
- F. Drawings show existing major underground utilities using the best information available. The Contractor shall also fully check public works reference drawings prior to excavation. Call local Dig Alert to locate utilities to ensure safety.
- G. Call local Dig Alert to locate utilities to ensure safety.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. On-site soils are suitable for engineered fill construction in structural areas provided the materials do not contain rubbish, rubble greater than three inches, and significant organic concentrations. Imported fill materials, if required, shall be compatible, granular soils with an Expansion Index of 20 or less, and contain no particles greater than three inches in maximum dimension. Imported soils shall be approved by our office prior to being transported to the site. Also, if imported fills are required (other than aggregate base), the contractor must provide appropriate documentation that the import is clean of known contamination per Department of Toxic Substance Control (DTSC) and within acceptable corrosion limits.

### **PART 3 EXECUTION**

#### **3.01 INSPECTION**

- A. Verify drawing dimensions and elevations with actual field conditions. Inspect related Work and adjacent surfaces and report discrepancies and conditions which prevent proper execution of the Work to the Owner's Representative.

#### **3.02 SUBGRADE IMPROVEMENTS**

- A. Subgrade preparation of the subgrade soils shall include all soils that has been disturbed and/or areas where existing structures are removed to provide a uniform layer of engineered fill for support of the planned structures.
- B. Due to the potential expansion characteristics of the native soils, the upper 12 inches of the final subgrade below the proposed buildings and exterior concrete flatwork shall consist of imported non-expansive engineered fill, or the native clay soils shall be chemically amended as noted below. The swimming pool may be supported directly on undisturbed native soils moisture conditioned to at least two percent above the optimum moisture content and maintained in that condition until the subgrade is covered with concrete.
- C. Following site clearing and stripping operations, areas to receive fill or to remain at-grade shall be scarified to a depth of at least 12 inches, moisture conditioned to a least two percent above the optimum moisture content and uniformly compacted to not less than 90 percent of the ASTM

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D 1557 maximum dry density or to the highest degree possible for the soil moisture content and stability at the time of construction. Scarification and recompaction shall extend at least five feet beyond the perimeter of buildings and two feet beyond the outer edge of pavements. Unstable areas may require a layer of geotextile reinforcement at the time of construction. The need for geotextile reinforcement shall be determined by the Geotechnical Engineer once the final subgrade has been exposed. All fill soils shall be compacted to at least 90 percent relative compaction.

- D. Compaction of all subgrade soils shall be performed using a heavy, self-propelled, sheepsfoot compactor capable of achieving the required compaction and must be performed in the presence of the Geotechnical Engineer's representative who will evaluate the performance of subgrade under compactive load. Difficulty in achieving subgrade compaction may be an indication of loose, soft or unstable soil conditions that could require additional excavation. If these conditions exist, additional subgrade stabilization recommendations may be required at the time of construction.
- E. Engineered fill shall be placed in lifts that do not exceed six inches in compacted thickness. Native or imported clayey materials shall be thoroughly moisture conditioned to at least two percent above the optimum moisture content and uniformly compacted to at least 90 percent of the ASTM D1557 maximum dry density. Approved granular imported fill materials shall be uniformly moisture conditioned to at least the optimum moisture content and compacted to at least 90 percent relative compaction. Relative compaction shall be based on the ASTM D1557 maximum dry density.
- F. The upper 12 inches of exterior flatwork areas, shall consist of non-expansive granular on-site or import soils compacted to at least 90 percent relative compaction at the optimum moisture content or above. Alternatively, the upper 12 inches may consist of lime-treated native clays compacted to at least 90 percent relative compaction at a moisture content of at least two percent above the optimum moisture content.

### 3.03 EXCAVATION

- A. Checking Layout: Contractor shall, before commencing the excavation work, check all lines, stakes and levels for dimensions, angles, elevations and grades with the survey.
- B. Dimensions: Excavate to proper dimensions as shown, cut square and smooth with firm level bottoms. Prepared excavations shall be approved by Geotechnical Engineer. Excavations shall be free of loose or disturbed materials.
- C. Excess Water Control: Keep all excavations free from standing water by pumping, draining or providing proper protection against water intrusion. If soil becomes soft, soggy or saturated, perform additional excavation to firm soil not affected by water.
- D. Form Removal: Make all excavations of sufficient size to permit installation and removal of forms and all other required work.
- E. Alternate Forming: Sides of structures may be formed by neat excavations where banks will stand without caving. If banks cave, provide forming as required and widen excavation to permit forming, bracing and inspection. Provide forming in conformance with Section 13 1102 and all recognized safety standards. Form all grade beams.

### 3.04 BACKFILLING

- A. Method: After concrete has been placed, forms removed and concrete work approved, backfill the excavations with earth to indicated or required grades. Carry on backfilling simultaneously on each side of walls or grade beams. Remove all rubbish and wood from the excavations before placing backfill.
- B. Concrete Protection: Prior to placing any backfill, adequately cure all concrete and provide any bracing required to ensure the stability of the structure. Protect waterproofing and dampproofing against damage in a manner acceptable to the Owner's Representative. Remove bracing as backfill operations progress.

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- C. The on-site granitic bedrock may be utilized for trench backfill once it is processed. The on-site lean and fat clay should not be used for trench backfill. Imported fill should be free of organic material and rocks over 2 ½ inches in diameter.
- D. Backfill of all trenches should be placed in thin lifts and mechanically compacted to achieve a relative compaction of not less than 95 percent in paved areas and 90 percent in other areas per ASTM 1557. Care should be taken not to damage utility lines.
- E. Moisture: Rigidly control the amount of water used to ensure optimum moisture conditions for the type of fill material used. Excessive amounts of water causing saturation of earth will not be permitted. Compaction by flooding or jetting is prohibited.

### **3.05 GRADING**

- A. Slopes: Grade to finish grades indicated on Drawings, with uniform slopes between all points.
- B. Subgrades: Blade to required grade and roll or tamp subgrades for exterior slabs, decks and paving.

### **3.06 CLEAN-UP**

- A. Disposal: Haul away rubbish, debris, and rocks from site promptly and dispose of legally. Burning rubbish on site is prohibited.
- B. Dust and Noise Abatement: During entire period of construction keep area and material being loaded sprinkled to reduce dust in air and annoyance to premises and surrounding property.

**END OF SECTION 13 1101**

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## SECTION 13 1102 SWIMMING POOL CONCRETE

### PART 1 GENERAL

#### 1.01 WORK INCLUDED

- A. Forming for cast-in-place concrete and shotcrete associated with swimming pools and pool decks.
- B. Reinforcement for cast-in-place concrete and shotcrete associated with swimming pools and pool decks.
- C. Cast-in-place concrete for swimming pool structures. Do not use waterproofing admixture of any kind.
- D. Cast-in-place concrete for swimming pool decks with Xypex C-500 crystalline waterproofing admixture. Waterproofing admixture for swimming pool decks only.
- E. Provide labor, materials and equipment as required to install sealant for all pool deck expansion joints, or any other caulking, as indicated on the aquatic Drawings and herein specified.

#### 1.02 QUALITY ASSURANCE

- A. Qualifications of Workers:
  - 1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
  - 2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years' experience with the materials and methods specified.
  - 3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years' experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.
- B. Standards:
  - 1. In addition to complying with the California Building Code (latest edition), comply with all pertinent recommendations contained in "Guide to Formwork," Publication ACI 347R-14 of the American Concrete Institute.
  - 2. In addition to complying with California Building Code (latest edition), comply with all pertinent recommendations contained in "Guide to Reinforcing Steel Design Details," Publication ACI 315R-18 of the American Concrete Institute.
  - 3. In addition to complying with all local codes and regulations, comply with all pertinent recommendations contained in American Society for Testing and materials (ASTM); ASTM C 920 "Standard Specification for Elastomeric Joint Sealants."
- C. Tolerances: Construct all swimming pool concrete straight, true, plumb and square within a tolerance horizontally of one in 200 and vertically of one in 2000.

#### 1.03 SUBMITTAL AND SUBSTITUTIONS

- A. Provide submittals in conformance with the requirements of Section 01 3300.
- B. Samples and Certificates, Concrete Reinforcement:
  - 1. Provide all data and access required for testing as described in Section 01 4500 of the Specifications.
  - 2. All material shall bear mill tags with heat number identification. Mill analysis and report shall be made available upon request.
  - 3. Material not so labeled and identifiable may be required by the Owner to be tested by the testing laboratory selected by the Owner and at no additional cost to the Owner, in which case random samples will be taken for one series of tests from each 2-1/2 tons or fraction thereof of each size and kind of reinforcing steel.

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4. Design mix from batch plant demonstrating previous use history and associated strengths at 28 days.
  5. The Contractor shall submit a mix design stamped and signed by a licensed engineer for approval by the Owner's Representative prior to any placement of concrete.
  6. The Contractor shall submit a separate mix design stamped and signed by a licensed engineer for the swimming pool decks which contains the specified Xypex C-500 crystalline waterproofing admixture for approval by the Owner's Representative prior to any placement of concrete.
- C. Submit proof of qualifications as specified in Article 1.02.A of this Section.
- D. Submit reinforcing shop drawings for pool walls, gutters, floors, dike walls and balance tank, etc. as shown on the construction drawing.

#### **1.04 PRODUCT HANDLING**

- A. Delivery: Deliver materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.
- B. Storage: Store materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project Site.
- C. Protection: Use all means necessary to protect the swimming pool concrete before, during, and after installation and to protect the installed Work specified in other Sections.
- D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner.

### **PRODUCTS**

#### **2.01 CONCRETE FORMWORK**

- A. Form Materials:
1. Form Lumber: All form lumber in contact with exposed concrete shall be new except as allowed for reuse of forms in Part 3 of this Section, and all form lumber shall be one of the following, a combination thereof, or an equal approved in advance by the Owner's Representative.
    - a. "Plyform," Class I or II, bearing the label of the Douglas Fir Plywood Association; "Inner-Seal" Form as manufactured by Louisiana-Pacific, or approved equal.
    - b. Douglas Fir-Larch, number two grade, seasoned, surfaced four sides.
  2. Form Release Agent: Colorless, non-staining, free from oils; chemically reactive agent that shall not impair bonding of paint or other coatings intended for use.
- B. Ties and Spreaders:
1. Type: All form ties shall be a type which do not leave an open hole through the concrete and which permits neat and solid patching at every hole.
  2. Design: When forms are removed, all metal reinforcement shall be not less than two (2) inches from the finished concrete surface.
  3. Wire Ties and Wood Spreaders: Do not use wire ties or wood spreaders.
- C. Alternate Forming Systems: Alternate forming systems may be used subject to the advance approval of the Owner's Representative.

#### **2.02 CONCRETE REINFORCEMENT**

- A. Bars: Bars for reinforcement shall conform to "Specifications for Deformed Carbon-Steel Bars for Concrete Reinforcement," ASTM A-615, Grade 60.
- B. Wire Fabric: Wire fabric shall conform to "Specifications for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete," ASTM A1064.
- C. Tie Wire: Tie wire for reinforcement shall conform to "Specifications for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete," ASTM A1064 black annealed 16-gauge tie wire.

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## 2.03 CAST-IN-PLACE CONCRETE

### A. Concrete:

1. All concrete, unless otherwise specifically permitted by the Owner's Representative, shall be transit-mixed in accordance with ASTM C94. Concrete for water retaining structures that do not receive a waterproofing finish such as ceramic tile or swimming pool plaster shall receive a topical waterproofing finish.
2. The control of concrete production shall be under the supervision of a recognized testing agency, selected by the Owner in accordance with Section 01 2500 of the Specifications.
3. Quality: All concrete shall have the following minimum compressive strengths at twenty-eight (28) days and shall be proportioned within the following limits:
  - a. 4,000 psi minimum compressive strength for cast-in-place concrete swimming pool structures.
  - b. 4,000 psi minimum compressive strength for cast-in-place swimming pool decks with Xypex C-500 waterproofing admixture.
  - c. 1" maximum size aggregate.
  - d. 6.0 minimum sacks of cement per cubic yard.\*
  - e. Maximum water to cement ratio of 0.40-0.45 maximum
  - f. 4" maximum slump.
  - g. Xypex Admix C-500 2% - 2.5% by weight of cement content. Contact Xypex Technical Services to confirm dosage. (To be used for swimming pool decks only.)
 

\* For estimate only: to be determined by mix design.
4. Cement: All cement shall be Portland Cement conforming to ASTM C-150, Type II or V and shall be the product of one manufacturer.
5. Aggregates:
  - a. Shall conform to "Standard Specifications for Concrete Aggregates," ASTM C33, except as modified herein.
  - b. Coarse Aggregate: Clean sound washed gravel or crushed rock. Crushing may constitute not more than 30% of the total coarse aggregate volume. Not more than 5% flat, thin, elongated or laminated material nor more than 1% deleterious material shall be present. 1" aggregate graded from 1/4" to 1", fineness modulus 6.90 to 7.40. 1-1/2" graded from 1/2" to 1-1/2", fineness modulus 7.80 to 8.20.
  - c. Fine Aggregate: Washed natural sand of hard, strong particles and shall contain not more than 1% of deleterious material, fineness modulus 2.65 to 3.05.
  - d. Aggregate must be certified, non-expansive from a "known" good source.
6. Water: ASTM C1602, Clean, fresh, free from acid, alkali, organic matter or other impurities liable to be detrimental to the concrete (potable).
7. Admixtures: Admixtures shall be used upon approval of the Owner's Representative.
  - a. Air-entraining admixture: Conform to ASTM C260.
  - b. Water-reducing admixture: Conform to ASTM C494.
  - c. Waterproofing admixture for swimming pool decks only: Xypex Admix C-500, no substitutions permitted. Conform to ASTM C494.
8. Xypex Admix C-500 Dosage: To be used for swimming pool decks only.
  - a. General: Xypex Admix must be added to concrete mix at time of batching. It is important to obtain a homogeneous mixture of Xypex Admix with the concrete. Do not add dry Admix powder directly to wet mixed concrete as this could cause clumping and thorough dispersion may not occur.
  - b. Dosage Rate: Under normal conditions, the crystalline waterproofing powder shall be added to the concrete mix at the following rates:
    - 1) Xypex Admix C-500 2% – 2.5% by weight of cement content
  - c. Weather Conditions: For mixing, transporting and placing concrete under conditions of high temperature or low temperature, follow concrete practices such as those referred to in ACI 305R (Hot Weather Concreting) and ACI 306R (Cold Weather Concreting) or other applicable standards.

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- d. Concrete Batching & Mixing Procedures: Procedures for the addition of Xypex admixture will vary according to type of batch plant operation and equipment. Prior to the placement of any concrete, the concrete batch plant and the contractor shall be responsible to consult with the local Xypex representative concerning additional procedures for the addition, mixing and to confirm dosage.

Note: For enhanced chemical protection or for meeting specific project requirements or where the concrete mix design contains higher than 25% type F fly ash content or includes a Portland cement/slag cement/type C fly ash blend, consult with manufacturer or its authorized representative to determine appropriate dosage rates.

- B. Construction Joints: Use keyform for slab pour joints. Either preformed galvanized or PVC construction joint forms of a standard manufacturer may be used. Install per manufacturer's recommendations and tool edges of slabs.
- C. Waterstops: PVC bulb-type for use between concrete pours / lifts, conforming with ASTM D 570, D 624, and D 638. Provide in configuration(s) as recommended by manufacturer for specific application. Greenstreak, W.R. Meadows, or approved equal.
- D. Curing Materials:
- E. Liquid Membrane (covered slab): Chlorinated rubber membrane forming, curing-sealing compound conforming to ASTM C309.
- F. Liquid Membrane (exposed slab): Clear methyl and butyl methacrylate non-staining, membrane forming, curing-sealing compound conforming to ASTM C309.
- G. Cement Grout and Drypack:
  - 1. Cement Grout: Mix 1 part by volume of Portland Cement, 1/2 part by volume of water and fine aggregate enough to make mixture flow under its' own weight.
  - 2. Drypack: Mix 1 part by volume of Portland Cement, 1/2 part by volume of water and fine aggregate enough to make a stiff mix that will mold into a ball. Mix no more than can be used in 30 minutes.

## 2.04 JOINT SEALANT MATERIALS

- A. Caulking: Multipart, non-sag gun grade polyurethane-based sealant meeting the requirements of ASTM C920-02, Type S or M, Mamemco International, Pecora, Sika Corp., Sonneborn Building Products, Tremco or approved equal. Self leveling caulking materials are not allowed.
- B. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- C. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- D. Sealant Backer Rod: Provide compressible polyethylene or polyurethane backer rod as recommended by the sealant manufacturer.
- E. Bond Breaker Tape: Provide polyethylene tape or other plastic tape as recommended by sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant.
- F. Sand: Cover the surface of the caulking with #30 silica sand.

## 2.05 OTHER MATERIALS

- A. All other materials, not specifically described but required for proper completion of the work of this Section, shall be as selected by the Contractor subject to the advance review by the Owner's Representative.

## PART 3 EXECUTION

### 3.01 SURFACE CONDITIONS

- A. Inspection:

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1. Prior to all Work of this Section, carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation may properly commence.
  2. Verify that all Work may be constructed in accordance with all applicable codes and regulations, the referenced standards, the original design, and in accordance with site specific Geotechnical Report.
- B. Discrepancies:
1. In the event of discrepancy, immediately notify the Owner's Representative.
  2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
  3. Failure to notify the Owner's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive work.

### 3.02 CONCRETE FORMWORK

- A. Construction of Forms:
1. General: Construct all required forms to be substantial, sufficiently tight to prevent leakage of concrete paste, and able to withstand excessive deflection when filled with wet concrete.
  2. Layout:
    - a. Form for all required cast-in-place concrete to the shapes, sizes, lines and dimensions indicated on the Drawings.
    - b. Exercise particular care in the layout of forms to avoid necessity for cutting concrete after placement.
    - c. Make proper provisions for all openings, offsets, recesses, anchorages, blocking and other features of the Work as shown or required.
    - d. Perform all forming required for Work of other trades and do all cutting and repairing of forms required to permit such installation.
    - e. Carefully examine the Drawings and Specifications and consult with other trades as required relative to providing for pipe and conduit penetrations, reglets, chases and other items in the forms.
  3. Imbedded Items: Set all required steel frames, angles, bolts, inserts and other such items required to be anchored in the concrete prior to concrete being placed.
  4. Bracings:
    - a. Properly brace and tie the forms together so as to maintain position and shape and to ensure safety to workmen.
    - b. Construct all bracing, supporting members and centering of ample size and strength to safely carry, without excessive deflection, all dead and live loads to which they may be subjected.
    - c. Properly space the forms apart and securely tie them together, using metal spreader ties that give positive tying and accurate spreading.
  5. Wetting: Keep forms sufficiently wetted to prevent joints from opening up before concrete is placed.
- B. Plywood Forms:
1. Design: Nail the plywood panels directly to studs and apply in a manner to minimize the number of joints.
  2. Joints: Make all panel joints tight butt joints with all edges true and square.
- C. Footing Forms:
1. Wood Forms: All footing forms shall be wood unless otherwise specifically approved by the Owner's Representative, or as specified in paragraph 3.02(C)(2).
  2. Earth Forms:

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- a. Side walls for footings may be of earth provided the soil will stand without caving and the sides of the bank are made with a neat cut to the minimum dimensions indicated on the Drawings.
  - b. For excavation and backfill of earth forms, conform with applicable provisions of Section 13 1101.
- D. Reuse of Forms:
  1. Reuse of forms shall be subject to advance approval of the Owner's Representative.
  2. Except as specifically approved in advance by the Owner's Representative, reuse of forms shall in no way delay or change the schedule for placement of concrete from the schedule obtainable if all forms were new.
  3. Except as specifically approved in advance by the Owner's Representative, reuse of forms shall in no way impart less structural stability to the forms nor less acceptable appearance to finished concrete.
- E. Removal of Forms:
  1. General:
    - a. In general, side forms of footings may be removed seven (7) days after placement of concrete, but time may be extended if deemed necessary by the Owner's Representative.
    - b. Forms for footings, foundations, grade beams, slabs, walls, and other formed concrete may be removed fourteen (14) days after placement of concrete.
  2. Removal:
    - a. Use all means necessary to protect workers, passersby, the installed Work of other trades and the complete safety of the structure.
    - b. Cut nails and tie wires or form ties off flush, and leave all surfaces smooth and clean.
    - c. Remove metal spreader ties on exposed concrete by removing or snapping off inside the wall surface and pointing up and rubbing the resulting pockets to match the surrounding areas.
    - d. Flush all holes resulting from the use of spreader ties and sleeve nuts using water, and then solidly pack throughout the wall thickness with cement grout applied under pressure by means of a grouting gun; grout shall be one-part Portland Cement to 2-1/2 parts sand; apply grout immediately after removing forms.

### 3.03 CONCRETE REINFORCEMENT

- A. Bending:
  1. General:
    - a. Fabricate all reinforcement in strict accordance with the Drawings.
    - b. Do not use bars with kinks or bends not shown on the Drawings.
    - c. Do not bend or straighten steel in a manner that will injure the material. (When opposite end is already encased in concrete.)
  2. Design:
    - a. Bend all bars cold.
    - b. Make bends for stirrups and ties around a pin having a diameter of not less than four (4) times the minimum thickness of the bar (#3-#5) per ACI.
    - c. Make bends for other bars, including hooks, around a pin having a diameter of not less than six (6) times the minimum thickness of the bar.
- B. Placing:
  1. General: Before the start of concrete placement, accurately place all concrete reinforcement, positively securing and supporting by concrete blocks, metal chairs or spacers, or by metal hangers.
  2. Clearance:
    - a. Preserve clear space between bars of not less than one and one-half (1-1/2) times the nominal diameter of the round bars.

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- b. In no case let the clear space be less than one and one-half (1-1/2) inches nor less than one and one-third (1-1/3) times the maximum size of the aggregate.
    - c. Provide the following minimum concrete covering of reinforcement:
      - 1) Concrete deposited against earth: three (3) inches minimum.
      - 2) Concrete below grade deposited against forms: two (2) inches minimum.
      - 3) Concrete elsewhere: As indicated on Drawings or otherwise approved by the Owner's Representative.
  - 3. Splicing:
    - a. Horizontal Bars:
      - 1) Place bars in horizontal members with minimum lap at splices sufficient to develop the strength of the bars.
      - 2) Bars may be wired together at laps except at points of support of the member, at which points preserve clear space described above.
      - 3) Whenever possible, stagger the splices of adjacent bars.
      - 4) Splice sixty-four (64) bar diameters minimum.
      - 5) Provide non-contact lap slices for shotcrete.
    - b. Wire Fabric: Make all splices in wire fabric at least one and one-half (1-1/2) meshes wide.
    - c. Other Splices: Make only those other splices that are indicated on the Drawings or specifically approved by the Owner's Representative.
  - 4. Dowels: Place all required steel dowels and securely anchor them into position before concrete is placed.
  - 5. Obstructions: In the event conduits, piping, inserts, sleeves and other items interfere with placing reinforcement as indicated on the Drawings or otherwise required, immediately consult with the Owner's Representative and obtain approval of a new procedure prior to placing concrete.
- C. Cleaning Reinforcement: Steel reinforcement, at the time concrete is placed around it, shall be free from rust scale, loose mill scale, oil, paint and all other coatings which will destroy or reduce the bond between steel and concrete. Bend down all tie wire away from the top of the pool deck. Maintain a 2" clear from top of concrete to the tie wire.

### **3.04 SHOTCRETE REINFORCEMENT**

- A. The maximum size of reinforcement shall be No. 5 bars unless it can be demonstrated by preconstruction tests that adequate encasement of larger bars can be achieved. When No. 5 or smaller bars are used, there shall be a minimum clearance between parallel reinforcement bars of 2-1/2 inches (64 mm). When bars larger than No. 5 are permitted, there shall be a minimum clearance between parallel bars equal to six diameters of the bars used. When two curtains of steel are provided, the curtain nearest the nozzle shall have a minimum spacing equal to 12 bar diameters and the remaining curtain shall have a minimum spacing of six bar diameters.
- B. Lap splices in reinforcing bars shall be by the non-contact lap splice method with at least 2 inches clearance between bars. The enforcement agency may permit the use of contact lap splices when necessary for the support of the reinforcing provided it can be demonstrated by means of preconstruction testing, that adequate encasement of the bars at the splice can be achieved, and provided that the splices are placed so that a line through the center of the two spliced bars is perpendicular to the surface of the shotcrete work.

### **3.05 CAST-IN-PLACE CONCRETE**

- A. Conveying and Placing Concrete:
  - 1. Before placing concrete, mixing and conveying equipment shall be well cleaned, and the forms and space to be occupied by concrete shall be thoroughly cleaned and wetted. Ground water shall be removed until the completion of the work.

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2. No concrete shall be placed in any unit of work until all formwork has been completely constructed, all reinforcement has been secured in place, all items to be built into concrete are in place, and form ties at construction joints tightened.
  3. Concrete shall be conveyed from mixer to place of final deposit in such a way to prevent the separation or loss of ingredients. It shall be placed as nearly as practicable in its' final position to avoid rehandling or flowing. Concrete shall not be dropped freely where reinforcing bars will cause segregation, nor shall it be dropped freely more than six (6) feet. Use tremies, spouts and dump boxes in deep sections. Vibrators are not acceptable for facilitating concrete transport.
  4. Concrete shall be tamped and spaded to insure proper compaction into all parts of forms and around reinforcement. A mechanical vibrator shall be used to thoroughly compact the concrete. Vibration must be by direct action in the concrete and not against forms or reinforcement.
  5. Mixing and transport time as indicated in ASTM C94 is required. If air temperatures are between 85° and 90° F the delivery time is to be reduced to 75 minutes. When air temperatures are in excess of 90° F the delivery time should be reduced to 60 minutes.
  6. Truck mixes without batch certificates will be rejected.
- B. Construction Joints / Expansion Joints: Construction joints and expansion joints shall be provided at locations and in the manner shown on the Drawings. With exception of existing concrete / new shotcrete joints, use PVC bulb-type waterstops appropriate for design condition between all concrete pours / lifts to avoid cold joints. Waterstops shall be placed in such a way to protect reinforcing steel from rust and oxidation. All expansion joints must be the full depth of the concrete section in which they are located.
- C. Slab Finishes: Concrete slabs shall be compacted and screeded uniformly to grades shown. Push large aggregates below the surface with a screen tamper, screed and bull float. As soon as the surface becomes workable, it shall be wood floated, then finished as indicated on the Drawings to a uniform smooth, true surface in a neat and workmanlike manner. Carefully coordinate slab finish requirements with other trades (ceramic tile, pool plaster) to ensure concrete finish is appropriate substrate for final finish material.
1. Contractor shall provide three mock-up deck samples, minimum 3'x 3', with a wedge anchor installed in one sample. These (3) samples shall be constructed; one with a light broom finish, one (1) with a medium broom finish and one (1) with a heavy broom finish for determination and selection of an appropriate deck finish. Each sample shall be edged on all four sides to demonstrate a 3/4" radius edge. Anchor installation shall demonstrate acceptable interface between anchor and the top of deck. Deck samples shall remain on job site through final inspection for reference.
  2. Pool Floor Slab: Heavy Wire Broom Finish.
- D. Protection and Curing:
1. Concrete shall be protected from injurious action of the elements and defacement of any nature during construction.
  2. All forms must be kept wet to prevent drying out of the concrete.
  3. All concrete surfaces including footings must be kept wet for at least seven (7) days after concrete is placed.
  4. Apply the appropriate curing materials, as specified in 2.03 of this Section, immediately after finishing slabs. Application shall be as specified by the manufacturer.
- E. Form Removal:
1. Take care in removing forms so that surfaces are not marred or gouged and that corners are true, sharp and unbroken.
  2. No steel spreaders, ties or other metal shall project from or be visible on any concrete surfaces.
- F. Defective Work:

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1. Should the strength of any concrete for any portion of the work indicated by tests of molded cylinders and core tests fall below minimum 28 days strength specified or indicated, concrete will be deemed defective work and shall be replaced.
2. Concrete work that is not formed as indicated, is not true to intended alignment, not plumb or level where so intended, not true to intended grades or elevations, not true to specified or selected finish, contains sawdust shavings, wood, or embedded debris, which exhibits cracks or contains fine or coarse sulfide particles, or expansive aggregates detrimental to performance or appearance of the concrete shall be deemed defective.
3. Promptly perform work required to replace and properly clean (by sandblasting if necessary) any defective concrete panels (control joint or expansion joint to control joint or expansion joint), at Contractor's expense, including all expense of additional inspection, tests, or supervision made necessary as a result of defective concrete.

### **3.06 EXPANSION JOINTS**

- A. Temperatures: Do not install sealants when air temperature is less than 40°F.
- B. Tooling: Tool exposed joints to a slightly concave surface using slicking materials recommended by the manufacturer. The tooling procedure shall press sealant against the sides of the joint. No materials shall be left "feathered" out or smeared on the abutting materials. Completed joints shall have a uniform professional appearance.
- C. Joint Construction: Sealant joint width, thickness and cross-sectional profile to be constructed in strict accordance with the sealant manufacturer's recommendations.
- D. Sand: At the appropriate time cover the sealant with sand to provide a sanded finish.

### **3.07 CLEAN-UP**

- A. Upon completion of the Work of this Section, immediately remove all swimming pool concrete materials, debris and rubbish occasioned by this Work to the approval of the Owner's Representative.

**END OF SECTION 13 1102**

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## SECTION 13 1103 SWIMMING POOL SHOTCRETE

### PART 1 GENERAL

#### 1.01 WORK INCLUDED

- A. Provide labor, materials and equipment as required to install wet mix shotcrete for swimming pool structures as indicated on the Drawings and herein specified.

#### 1.02 QUALITY ASSURANCE

- A. Qualifications of Workers:
  - 1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
  - 2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years' experience with the materials and methods specified.
  - 3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years' experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.
- B. Standards: Except as otherwise indicated, provide shotcrete per American Concrete Institute Standard ACI 506. In addition, conform to recommendations contained in "Shotcrete," Brochure G-84 as published by the Gunite Contractors Association, Sylmar, California and the California Building Code (latest edition).
- C. Mix Design: The Contractor shall submit a mix design stamped and signed by a licensed engineer for approval by the Owner's Representative prior to any placement of shotcrete. Mix design shall indicate source of aggregate and brands of cement and admixtures used. All mix designs shall take character of locally available aggregate into consideration and make adjustments as necessary to conform with specified design criteria.
- D. Testing and Inspection: A test panel shall be shot, cured, cored or sawn, examined and tested (representing the most congested and difficult project scenario) prior to commencement of the project in accordance with ASTM C1140. All project conditions and personnel shall be represented in the test panel. Additionally, one test panel shall be provided for each 50 yards (or portion thereof) of shotcrete placed for each day or each nozzleman, whichever is greater. The size of the strength test panel shall be per the direction of the Special Shotcrete Inspector. At least three (3) cores shall be taken from each test panel. (At least three (3) cores shall be taken from the completed work for each day of shotcrete operation.) Testing shall be performed by the Owner's designated Testing Lab and comply with Section 1908A.10, California Building Code. Continuous inspection of the shotcrete operation by a deputy inspector provided by the Owner shall be required. Inspection of shotcrete work shall comply with Section 1908A of California Building Code, and coring, sampling, soaking and testing per 1908A.5 and 1908A.10 of California Building Code. Contractor shall provide test panels for all required tests. The Contractor shall provide the Owner and Testing Lab 48 hours' notice before the start of shotcrete operations.
- E. Tolerances: Construct all swimming pool shotcrete straight, true, plumb and square within a tolerance horizontally of one in 200 and a tolerance vertically of one in 2000.

#### 1.03 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in conformance with the requirements of Section 01 3300.
- B. Materials List: Within thirty (30) days after issuance of Notice to Proceed, and before shotcrete materials are delivered to the project site, submit to the Owner a complete list of materials proposed to be used in this portion of the Work, showing manufacturer's name and catalog

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number of all items such as admixtures and curing membranes, and the name and address of the supplier of cement and aggregate to be used.

- C. Submit proof of qualifications as specified in Article 1.02.A of this Section.

#### 1.04 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect shotcrete materials before, during and after installation and to protect the installed Work specified in other Sections.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no additional cost to the Owner.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. Cement: Cement shall be Type II Portland Cement conforming to ASTM C150. Cement type shall be the same for all shotcrete work.
- B. Aggregate: ASTM C33, washed hard dense durable clean sharp sand from approved pit, free of organic matter and opaline, feldspar, or silicious magnesium substances and containing not more than 3% by weight of deleterious substances. Maximum size aggregate for wet mix shotcrete is 3/8" per CBC 1908A.3. When tested for organic impurities by ASTM C40 method, fine aggregate color not darker than reference standard color. When tested for soundness by ASTM C88 method, grading No. 2 of ASTM C1436, loss after 5 cycles not over 10% of fine aggregate. Aggregate grading for wet mix shotcrete per ACI 506R-16 Table 1.1.1 below.

Sieve Size, U.S. Standard Square Mesh	Percent by Weight Passing Individual Sieves
	Grading
¾ in. (19 mm)	-
½ in. (12 mm)	100
3/8 in. (10 mm)	90 to 100
No. 4 (4.75 mm)	70 to 85
No. 8 (2.4 mm)	50 to 70
No. 16 (1.2 mm)	35 to 55
No. 30 (600 µm)	20 to 35
No. 50 (300 µm)	8 to 20
No. 100 (150 µm)	2 to 10

- C. Water: Potable, clean, fresh, free from acid, alkali, organic matter or other impurities liable to be detrimental to the shotcrete.
- D. Admixtures: Admixtures shall conform to ASTM C1141 and only be used upon approval of the Owner's Representative.

### PART 3 EXECUTION

#### 3.01 EXECUTION

- A. Inspection:
1. Prior to all Work of this Section carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation may properly commence.

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2. Verify that items to be imbedded in shotcrete are in place and that shotcrete may be placed to the lines and elevations shown on the Drawings, with all required clearance from reinforcement.
- B. Discrepancies:
1. In the event of discrepancy, immediately notify the Owner's Representative.
  2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
  3. Failure to notify the Owner's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive the Work.

### 3.02 PREPARATION

- A. General:
1. Thoroughly clean all areas where shotcrete is to be placed to insure proper bonding of shotcrete.
  2. Where shotcrete is to be placed against smooth surfaces (i.e., cast-in-place concrete), sandblast surfaces to receive shotcrete to provide clean aggregate surface, thereby insuring proper bond between materials.
- B. Ground Wires: Adequate ground wires, to be used as screeds, shall be installed to establish the thickness and surface planes of the shotcrete work. Ground wires shall be placed so that they are tight and true to line and grade and in such a manner that they can be easily tightened.

### 3.03 PROPORTIONING AND MIXING

- A. Accurately control proportion of water to Portland cement to produce thorough and uniform hydration of the shotcrete that, when shot, forms a homogeneous mass containing neither sags nor dry sand formation. Proportion by mass per ASTM C94 or by volume per ASTM C685.
- B. Shotcrete shall have a minimum compressive strength of 4,000 PSI at 28 days. Shotcrete material shall have a water/cement ratio of 0.40-0.45 per ACI 506.2, Chapter 6, Proportioning and Preconstruction Testing; Section 6.03.3, Wet Mix Process.
- C. Discontinue shotcrete work if the time between the addition of mixing water to cement and aggregate, or cement to aggregates, and placement of shotcrete exceeds ninety (90) minutes when the ambient temperature is below 85 degrees Fahrenheit, or exceeds sixty (60) minutes when the ambient temperature is above 85 degrees Fahrenheit. Batch, mix and deliver wet-mixture shotcrete per ASTM C94 or C685.
- D. Hot Weather Shotcreting – Unless otherwise specified, do not place shotcrete when shotcrete temperature is above 95°F, unless prequalification testing shows that the required quality of materials can be achieved at high temperatures. The temperature of reinforcement and receiving surfaces shall be below 90°F prior to shotcrete placement.
- E. Cold Weather Shotcreting – Unless otherwise specified, shooting may proceed when ambient temperature is 40°F and rising. Stop shooting when ambient temperature is 40°F and falling, unless measures are taken to protect the shotcrete. Shotcrete material temperature, when shot, shall not be less than 50°F. Do not place against frozen surfaces.

### 3.04 SHOTCRETE PLACING, FINISHING, AND CURING

- A. Operations: Utilize a standard type of air compressor, capable of providing a minimum of 250 cubic feet of air per minute per nozzle.
- B. Placing: Except when shooting reinforcing, hold the nozzle perpendicular to and 2-1/2 to 3 feet from surface. At reinforcing bars, hold the nozzle so as to direct shotcrete behind the bars, and shoot each side of each bars separately. A nozzleman's helper equipped with an air jet shall precede the nozzle and blow out rebound or sand lodged behind bars, on forms, or placed shotcrete. Placing shotcrete horizontal members from the top is not allowed unless approved methods are employed to eliminate all rebound. Material shall emerge from the nozzle in a

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uniform flow. If flow becomes intermittent for any reason, direct the nozzle away from the surface until the flow is again steady and constant. Do not reuse rebound or loose sand for any purpose.

- C. Puddled Shotcrete: Use of "puddled shotcrete" in which the air pressure is reduced and the water content is increased to facilitate placing in difficult locations is not allowed. Do not place shotcrete where nozzle stream cannot impinge directly on the involved surface. Where difficult shooting conditions occur, obtain proper results by maintaining correct air pressure and water ratio and reduce supply of material.
- D. Construction Joints: Form joints with sloping beveled edges. Clean and dampen the hardened joint surfaces before placing additional shotcrete. Square edged construction joints are not allowed. The film of laitance which forms on the surface of the shotcrete shall be removed within approximately two hours after application by brushing with a stiff broom. If this film is not removed within two hours, it shall be removed by thorough wire brushing or sand blasting. Construction joints over eight hours old shall be thoroughly cleaned with air and water prior to receiving shotcrete.
- E. Finishing: Rod exposed surfaces to true planes and lines on reaching the thickness and plane established by forms and ground wires. Tamp and wood float surfaces level and provide a rough raked finish. Carefully coordinate finish requirements with other trades (ceramic tile, pool plaster) to ensure shotcrete finish is appropriate substrate for final finish material.
- F. Curing: Keep shotcrete continuously damp for not less than seven (7) days after placing. Use sealed curing sheeting or other approved curing method where water curing is not feasible. Do not use curing compound of any kind.

### **3.05 DEFECTIVE WORK**

- A. Cut out, remove and replace, or repair to the satisfaction of the Owner's Representative, shotcrete not meeting minimum strength, not true, plumb or level, not to required elevations, containing cracks detrimental to performance or appearance, containing shavings, debris or with honeycombs or voids.
- B. Promptly perform Work required to repair, patch, replace, render properly cleaned surfaces (by sandblasting if necessary) or otherwise make good any defective shotcrete at Contractor's expense, including all expense of additional inspection, tests, or supervision made necessary as a result of defective shotcrete.

### **3.06 CLEAN-UP**

- A. Upon completion of the Work of this Section, immediately remove all swimming pool shotcrete materials, debris and rubbish occasioned by this work to the approval of the Owner's Representative.

**END OF SECTION 13 1103**

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## SECTION 13 1104

### SWIMMING POOL CERAMIC TILE

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. Swimming pool ceramic tile detailed on the Drawings, including, but not limited to, the following:
  - 1. Waterline Face Tile. (Deep Gutter Pool)
  - 2. Gutter Cap Tile. (Deep Gutter Pool)
  - 3. Lane Line / Target Tile / 4'-6" Depth Tile
  - 4. Depth Marker Tile. (At Cantilever Deck Face)
  - 5. Depth / Caution Marker Tile. (At Deep Gutter Pool Deck)
  - 6. Trim Tile (at Steps.)

##### 1.02 QUALITY ASSURANCE

- A. Qualifications of Workers:
  - 1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
  - 2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years' experience with the materials and methods specified.
  - 3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years' experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.
- B. Standards: In addition to complying with all pertinent codes and regulations:
  - 1. Manufacture of all tile shall be in accordance with ANSI A-137.1.
  - 2. Install ceramic tile in accordance with the recommendations contained in the 2021 "Handbook for Ceramic Tile Installation" of the Tile Council of America, Inc.
- C. Tolerances: Install all swimming pool ceramic tile straight, true, plumb and square within a tolerance horizontally of one in 200 and a tolerance vertically of one in 500. Waterline and gutter bullnose tile shall be level to 1/8" (+/- 1/16") around entire perimeter of swimming pools.

##### 1.03 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in conformance with the requirements of Section 01 3300.
- B. Samples: Submit samples of each color and pattern in the specified groups. Character samples can be representative for review prior to screening of actual tile.
- C. Master Grade Certificate: Prior to opening ceramic tile containers, submit a Master Grade Certificate, signed by the manufacturer of the tile used and issued when the shipment is made, stating the grade, kind of tile, identification marks for the tile containers, and the name and location of the Project.
- D. Specifications: Submit manufacturer's recommended installation specifications for the Work.
- E. Submit proof of qualifications as specified in Article 1.02.A of this Section.

##### 1.04 PRODUCT HANDLING

- A. Delivery: Deliver all materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.
- B. Storage: Store all materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project site.
- C. Protection: Use all means necessary to protect swimming pool ceramic tile before, during and after installation and to protect the installed Work specified in other Sections.

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- D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner's Representative.

## **PART 2 PRODUCTS**

### **2.01 TILE**

- A. Waterline Face Tile: (Deep Gutter Pool)
  - 1. Material: All waterline face tile shall be glazed ceramic tile (Group III standard) as manufactured by Dal-Tile or approved equal.
  - 2. Size: 6 x 6 inches.
  - 3. Color: Dal-Tile #D-029, 'Sky Blue'. Contact Kylee Midura [kylee.midura@daltile.com](mailto:kylee.midura@daltile.com) (858) 344-0019.
- B. Gutter Cap Tile: (Deep Gutter Pool)
  - 1. Material: All gutter cap tile shall be glazed ceramic tile (Group III standard) as manufactured by Dal-Tile or approved equal.
  - 2. Size: 2-1/2 x 6 inches (#A-7250).
  - 3. Color: Dal-Tile #D-029, 'Sky Blue'.
- C. Lane Line / Target / 4' - 6" Depth Tile:
  - 1. Material: Group 3 quality, frost proof unglazed ceramic mosaic tile with absorption rate of less than 1% as manufactured by Dal-Tile or approved equal.
  - 2. Size: 1 x 1 inches.
  - 3. Color: Dal-Tile #D-311, 'Black' in 25-yard lane direction and #D023 'Galaxy Blue' at 50M lane direction and 4'-6" depth marker.
- D. Depth Marker Tile (At Cantilever Deck Face):
  - 1. Material: All depth marker tile shall be glazed ceramic tile as manufactured and/or distributed by Dal-Tile, Precision Tile Co., or approved equal.
  - 2. Size: 4-1/4 x 4-1/4 inches.
  - 3. Color: Dal-Tile #X-114, 'Desert Gray' with Black silk screen numbers.
- E. Depth / Caution Marker Tile (at deep gutter pool deck):
  - 1. Material: Group 3 quality, frost proof unglazed ceramic mosaic tile with absorption rate of less than 1% as manufactured by Dal-Tile or approved equal.
  - 2. Size: 1 x 1 inches.
  - 3. Color: Dal-Tile #D-311, 'Black' letters and numbers on #D-014, 'Light Gray' field.
- F. Trim Tile (on underwater steps):
  - 1. Material: Group 3 quality, frost proof unglazed ceramic mosaic tile with absorption rate of less than 1% as manufactured by Dal-Tile or approved equal.
  - 2. Size: 1 x 1 inches with S-812 quarter round. Color: Dale-Tile #D-311. 'Black'.
  - 3. Size 2 x 6 inches with integral quarter round. Color: Black, non-slip. Inlays #CPC00022.

### **2.02 MORTAR**

- A. Sand for Mortar: Comply with requirements of fine aggregate for concrete.
- B. Cement: Type I Portland Cement, conforming to ASTM C150.
- C. Hydrated Lime: Conforming to ASTM C206 or 207, Type S.
- D. Water: From a potable source.
- E. Mortar shall meet ASTM C270 standard.

### **2.03 THIN SET MORTAR**

- A. Laticrete 254 Platinum. Laticrete, Custom or equal.
- B. Water: From a potable source.
- C. Mortar shall meet ASTM C627.

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## **2.04 GROUT**

- A. All tile grout shall be waterproof grout complying with the recommendations of TCA and ANSI A118.6 (4) standards. Grout color shall be grey for dark backgrounds, white for light backgrounds (verify colors with Architect).

## **2.05 OTHER MATERIALS**

- A. All other materials, not specifically described but required for a complete and proper installation of ceramic tile as indicated on the Drawings, shall be new, first quality of their respective kinds, and subject to the approval of the Owner's Representative.

# **PART 3 EXECUTION**

## **3.01 SURFACE CONDITIONS**

- A. Inspection:
  - 1. Prior to all Work of this Section, carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation may properly commence.
  - 2. Verify that ceramic tile can be installed in accordance with the original design and all referenced standards.
- B. Discrepancies:
  - 1. In the event of discrepancy, immediately notify the Owner's Representative.
  - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
  - 3. Failure to notify the Owner's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive its Work.

## **3.02 INSTALLATION**

- A. Method:
  - 1. Install all ceramic tile in strict accordance with installation method P601-90 of the 2021 Handbook for Ceramic Tile Installation of the Tile Council of America, Inc.
  - 2. Be certain to install all ceramic tile perfectly level, flush, plumb, and to the finish grades and elevations indicated on the Drawings.
- B. Interface:
  - 1. Carefully establish and follow the required horizontal and vertical elevations to insure proper and adequate space for the work and materials of other trades.
  - 2. Coordinate and cooperate as required with other trades to insure proper and adequate interface of ceramic tile Work with the Work of other trades.

## **3.03 GROUTING**

- A. Follow grout manufacturer's recommendations as to grouting procedures and precautions.
- B. Remove all grout haze, observing grout manufacturer's recommendations as to use of acid and chemical cleaners.

## **3.04 EXTRA STOCK**

- A. Provide one (1) unopened box of extra tile for 2.01A, 2.01B, and 2.01C for Owners use at a future time.

## **3.05 CLEAN-UP**

- A. Upon completion of the swimming pool ceramic tile installation, thoroughly clean and polish the exposed surfaces of tile work. Completely clean work area of debris and rubbish occasioned by this Work and dispose of to the approval of the Owner's Representative.

**END OF SECTION 13 1104**

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## SECTION 13 1105 SWIMMING POOL PLASTER

### PART 1 GENERAL

#### 1.01 WORK INCLUDED

- A. Swimming pool plaster and waterproofing of swimming pool structures as indicated on the Drawings and herein specified.
- B. Start-up and operation instructions to Owner's operations and maintenance personnel and properly balance swimming pool water chemistry until the Owner takes occupancy.

#### 1.02 QUALITY ASSURANCE

- A. Qualifications of Workers:
  - 1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
  - 2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years' experience with the materials and methods specified.
  - 3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years' experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.
- B. Standards: Swimming pool plaster shall conform with requirements of Chapter 31B of California Building Code, latest edition. In addition, meet requirements of applicable portions of most current edition of the "Technical Manual," National Plasterers Council, Mission Viejo, California.
- C. Start-up:
  - 1. Furnish a swimming pool water chemistry consultant, with a minimum of five (5) years' experience, possessing either AFO (Aquatic Facility Operator) or CPO (Certified Pool Operator) certification(s), to supervise and properly balance swimming pool water chemistry.
  - 2. Demonstrate to the Owner that all systems are fully operational and that calcium hardness, total alkalinity, chlorine residual and pH levels are within specified limits.
  - 3. Standards: Furnish labor and chemicals as required to condition the water properly to the following specifications:
    - a. Calcium Hardness: 200-400 parts per million (PPM)
    - b. Total Alkalinity: 80-100 PPM, minimum
    - c. Chlorine Residual: 1.00 to 2.00 PPM
    - d. pH Factor: 7.2 to 7.6

#### 1.03 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in conformance with the requirements of Section 01 3300.
- B. Submit proof of qualifications as specified in Article 1.02 and 1.02.C.1 of this Section.

#### 1.04 PRODUCT HANDLING

- A. Delivery: Deliver materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.
- B. Storage: Store materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project Site.
- C. Protection: Use all means necessary to protect the swimming pool plaster before, during, and after installation and to protect the installed Work specified in other Sections.
- D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner.

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### **1.05 ENVIRONMENTAL CONDITIONS**

- A. No plastering shall be done under unsuitable conditions of weather or temperature. No plastering shall be done when prevailing temperature is 40 degrees Fahrenheit or less.
- B. Do not install plaster during rain and, if rain commences after plastering has begun, immediately protect the plaster from rain by all means necessary until the plaster has set.
- C. Do not install plaster during wind greater than 10 mph and, if wind commences after plastering has begun, immediately protect the plaster from wind by all means necessary until the plaster has set.

## **PART 2 PRODUCTS**

### **2.01 CEMENT / AGGREGATE**

- A. Luna Quartz® tiny pebble finish by Wet Edge Technologies. Altima® quartz finish by Wet Edge Technologies. Pebble-Fina® pool finish by Pebble Technologies.

### **2.02 COLOR**

- A. All swimming pool plaster shall be white in color. Wet Edge Technologies shall be Luna Quartz® "Polar White". Wet Edge Technologies shall be Altima® "White". Pebble Technology shall be Pebble-Fina® "Classico". Contractor to obtain written approval on selected pebble color from the local Health Department prior to installation. Submit cut sheet, color sample and written approval for review by Architect and Owner

### **2.03 WATER**

- A. Water for swimming pool plaster shall be clean and free from injurious amounts of acid, alkali, and organics.

### **2.04 GUTTER, PUMP PIT, BACKWASH PIT & SURGE CHAMBER WATERPROOFING**

- A. Xypex, Miracote Miraflex Membrane C, or approved equal. Mix and apply per manufacturer's recommendations for specific application. Color shall be Gray.

## **PART 3 EXECUTION**

### **3.01 SURFACE CONDITIONS**

- A. Inspection:
  - 1. Prior to Work of this Section, carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation can properly commence.
  - 2. Verify that swimming pool plaster can be installed in accordance with the original design and all referenced standards, including proprietary application techniques and application training/certifications.
- B. Discrepancies:
  - 1. In the event of discrepancy, immediately notify the Owner's Representative.
  - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
  - 3. Failure to notify the Owner's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive the Work.

### **3.02 INSTALLATION OF GUTTER, PUMP PIT, BACKWASH PIT & SURGE CHAMBER WATERPROOFING**

- A. Provide two (2) coats of the specified gutter and surge chamber waterproofing prior to plastering the swimming pool. Prepare surfaces to receive waterproofing and cure in conformance with manufacturer's recommendations. Provide steel trowel application method to ensure uniform smooth, dense surface finish.

### **3.03 INSTALLATION OF POOL PLASTER**

- A. Outdoor Pools or Spas:

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1. Completion of other work: DO NOT commence plastering of swimming pool(s) or spa(s) until the following conditions have been met:
  - a. The Health Department and/or other governing agencies have approved the pool(s) and/or spas) for plaster.
  - b. All concrete pool deck construction is complete and the pool decks have been thoroughly cleaned.
  - c. All landscaping in areas adjacent to the pool(s) or spa(s) is complete and the landscape irrigation system is operable.
  - d. All painting in the pool area is complete.
  - e. All welding and grinding in locations adjacent to the pool area are complete.
  - f. The backwash sewer connection is complete.
  - g. Pool(s) and/or spa(s) area(s) perimeter fencing installation is complete.
  - h. All trash and debris have been removed from areas adjacent to the pool(s) or spa(s), particularly those areas that are normally upwind from the pool(s) or spa(s).
  - i. All dust raising construction and/or activities in areas adjacent to the pool(s) or spa(s) are complete or mitigated.
  - j. The circulation pump(s) is/are operational.
  - k. The mechanical system has been flushed sufficiently to remove all dirt and debris from the piping system.
  - l. All necessary chemicals (Chlorine, pH adjuster, Sodium Bicarbonate and Calcium Chloride or any other required chemicals) are on site and ready for use.
  - m. Obtain written approval from the Owner and the Architect.
- B. Indoor Pools or Spas:
  1. Completion of Other Work: DO NOT commence plastering of swimming pool(s) or spa(s) until the following conditions have been met:
    - a. The Health Department has approved the pool(s) and/or spa(s) for plaster.
    - b. All work above the pool(s) and/or spa(s) is complete.
    - c. All painting in the pool area is complete.
    - d. All welding and grinding in locations adjacent to the pool area are complete.
    - e. The backwash sewer connection is complete.
    - f. All concrete pool deck construction is complete and the pool decks have been thoroughly cleaned.
    - g. The circulation pump(s) is/are operation.
    - h. The mechanical system has been flushed sufficiently to remove all dirt and debris from the piping system.
    - i. All necessary chemicals (Chlorine, Acid, Sodium Bicarbonate and Calcium Chloride) are on site and ready to use.
    - j. Obtain written approval from the Owner and the Architect.
- C. Contractor accepts all liability from damage done to the pool plaster if the pool(s) or spa(s) is (are) plaster before the completion of the above listed items or without the written approval of the Owner and the Architect.
- D. POOL PLASTER AUTHORIZATION FORM:
  1. The pool(s) and or spa(s) at Davis Senior High School is/are hereby approved for the installation of the pool plaster. Pursuant to the requirements of specification section 13 1105, paragraph 3.03.

\_\_\_\_\_  
Owner

\_\_\_\_\_  
Date

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\_\_\_\_\_  
Architect / Project Manager

\_\_\_\_\_  
Date

E. Preparation:

1. Do not apply plaster over dirt, rust, scale, grease, moisture, scuffed surfaces or conditions otherwise detrimental to the formation of a durable plaster finish.
2. Consult with manufacturer on application to specific surfaces being treated. Follow manufacturer's recommendation for curing of cast-in-place concrete or shotcrete surfaces prior to application of plaster.
3. Protect ceramic tile, decking, deck equipment, gratings, fittings and other items by suitable covering or masking.
4. Mask or remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures and similar items in place not to receive pool plaster. Following completion of plaster for each space or area remove masking. Re-install all removed items utilizing workers skilled in the trades involved.

F. Application:

1. Finish shall be applied to a uniform thickness of 3/8" to 1/2" over the entire surface. The walls shall be scratch-coated followed by a finish coat. Material applied to the floor after the walls have been applied shall be accelerated to assure uniform setting time throughout the pool surface.
2. Float the plaster to a uniform plane and trowel to a smooth, dense, impervious surface using extreme care to avoid stains.
3. Take special care in finishing around pool fittings, making sure to mask off or plug openings so as not to fill such openings with excess plaster. Be certain to completely enclose pool fittings with plaster to insure a leak-proof seal around pipes, fittings, lights, anchors, etc.
4. Accurately interface with the finish planes of items installed by other trades.
5. Quartz-cement plaster is to be applied by a licensed applicator as approved by the manufacturer, and in accordance with manufacturer's training.

### 3.04 CURING

- A. Preparation: Anticipate the need for required equipment and have all such equipment immediately available for use upon completion of pool plastering.
- B. Pool Filling:
  1. After the plaster has sufficiently dried and before drying has proceeded to a damaging point, cure the plaster by gradually filling the pool with water, preventing all damage to finished plaster surfaces.
  2. Flow the water continuously until the pool is filled.
  3. When the weather is hot and/or water pressure is low, keep the pool walls damp while the pool is filling.
  4. Coordinate with Contractor to ensure that the pool is continuously monitored while filling to prevent overflow.

### 3.05 EQUIPMENT ACTIVATION

- A. All water chemistry and filtration mechanical equipment shall be operational upon filling of pool after plaster. Chemicals and other related support items as supplied by Contractor, shall be in supply at start-up.
- B. For the first fourteen (14) calendar days after completion of the pool plaster, brush all plastered surfaces at least twice a day and coordinate with General Contractor to ensure that the plaster is carefully maintained after the initial fourteen-day period. In addition, coordinate with the Contractor to ensure that pool filtration equipment is continuously running during the initial fourteen-day period.
- C. Start-up and provide qualified personnel to operate pool equipment for a period not less than fourteen (14) days after the pool is placed in operation, or until the Owner takes occupancy of

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the facility or letter of substantial completion. During this time, Contractor shall instruct and supervise the Owner's personnel in the various operating and maintenance techniques involved. Contractor shall be responsible for supply of chemicals during this not less than fourteen (14) day period and at time of turnover to Owner, chemical storage tanks shall be full. (Owner's personnel shall be fully trained and capable of assuming swimming pool maintenance tasks, training may begin before Owner takes occupancy).

### **3.06 CLEAN-UP**

- A. Upon completion of swimming pool plaster, remove all materials, equipment and debris occasioned by this Work and leave the job site in a clean and presentable condition. Perform all such clean-up to the approval of the Owner's Representative.

### **3.07 WARRANTY**

- A. All applicators must provide a minimum of five (5) year warranty for application and workmanship additional to the manufacturer's warranty for product.

**END OF SECTION 13 1105**

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## SECTION 13 1106 SWIMMING POOL EQUIPMENT

### PART 1 GENERAL

#### 1.01 WORK INCLUDED

- A. Swimming pool equipment items required for this Work as indicated on the Drawings and specified herein.

#### 1.02 QUALITY ASSURANCE

- A. Qualifications of Workers:
  1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
  2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years experience with the materials and methods specified.
  3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.
- B. All equipment supplied or work performed shall comply with regulations governing public swimming pools and spas as contained within Chapter 31 of California Building Code, latest edition.

#### 1.03 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in conformance with the requirements of Section 01 3300.
- B. Required submittals include:
  1. Swimming Pool Safety Equipment and Maintenance Equipment as specified in Article 2.01 and 2.02 of this Section.
  2. Swimming Pool Fittings, Deck and Mechanical Equipment as specified in Article 2.03-2.12 of this Section.
- C. Submit proof of qualifications as specified in Article 1.02.A of this Section.
- D. The equipment shown on the plans represent the first listed items in the technical specifications. The Contractor shall be responsible for all required field coordination and installation of any approved equal product to provide a fully working and warranted system. The Contractor shall submit detailed shop drawings for any products used other than the first listed specified items. Contractor provided shop drawings shall include details and quality equal to the original plans and construction documents. The Contractor shall provide any and all required engineering including but not limited to structural and anchorage requirements for any proposed equipment other than the first listed specified equipment. The Contractor is responsible to provide a factory certified representative(s) to start-up and provide on-site training for all swimming pool mechanical equipment provided.

#### 1.04 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect swimming pool equipment items before, during and after installation and to protect the installed work specified in other Sections.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner's Representative.

### PART 2 PRODUCTS

#### 2.01 SAFETY EQUIPMENT

- A. First Aid Kit for 50 Persons with two (2) wool blankets: Marine Rescue or approved equal. Quantity as required by the Department of Health, one (1) minimum.

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- B. Rescue Tubes (minimum 49" long) and Life Ring Buoy (minimum 24" in diameter) U.S. Coast Guard Approved: Marine Rescue or approved equal. Quantity as required by the Department of Health, two (2) minimum.
- C. Throw Rope (3/16" diameter) complete with lemon foot, for use with Life Ring Buoy: Kiefer, United Industries, or approved equal. Quantity as required by the Department of Health, two (2) minimum.
- D. Rescue Hooks, 16' long x 1-1/2" aluminum pole and stainless-steel mounting hardware: Kiefer, Pentair, or approved equal. Quantity as required by the Department of Health, two (2) minimum.
- E. Pool Safety Signs: As required by the Department of Health. Submittal required. Placement at the pool site shall be in conformance with Health Department Inspector. One (1) set minimum.
- F. Eyewash / Shower: Haws model #8309WC CRP combination eyewash / shower, with corrosion resistant protection. Two (2) required. See MEP sheets for water supply piping.

## 2.02 MAINTENANCE EQUIPMENT

- A. Commercial Pool Vacuum: Provide pool vacuum cart with lid-mounted handle, separate lid-mounted bracket for electrical cord, and two rubber-tired ball bearing wheels with grease fittings. Cart and filter shall be fabricated from schedule 304 stainless steel with welds treated and passified. Provide an all-bronze pump with a 1 1/2 hp, 115/230 volt, maximum 20 amp draw @ 120 volts, single phase motor and a 6" bronze trap. Pump shall be UL and NSF listed, have 2" suction and 1 1/2" discharge fittings, and have a brass priming valve with hose bib. Entire pump assembly shall be anchored to vacuum cart with two stainless steel bolts. Provide a 100 foot 10 AWG 3/C SJ electrical cord with ground fault interrupter (GFI) plus. Cord shall be wired to a double pole, 30-amp switch which shall be mounted on pump motor. One (1) required.
- B. Heavy Duty Vacuum Hose: 2" x 50', with hose connector. Pentair, Smooth Bore or approved equal. Two (2) required.
- C. Utility Pole: 24' fiberglass with connectors. Pentair, Skimlite or approved equal. Two (2) required.
- D. Commercial Vacuum Head: 24" wide "flexible" vacuum head. Pentair Model #R201186, or approved equal. One (1) required.
- E. Pool Wall Brush: 36" wide professional quality. Pentair or approved equal. One (1) required.
- F. Leaf Skimmer: 30" x 8" x 12", professional quality. Pentair, Spectrum or approved equal. One (1) required.
- G. Water Quality Test Kit, Professional Grade, Taylor Technologies Model #1741C, LaMotte Model #PRO250-NJ, or approved equal. One (1) required.

## 2.03 FITTINGS

- A. Main Drain Frame & Grate (18" x 36"): Lawson Aquatics #MLD-SG-1836, Super Sump with VGB Compliant Grates, or approved equal, two (2) required. Provide two (2) Hayward #SP-1056 1-1/2" collector tubes and two (2) #SP-1055 Hayward 1-1/2" hydrostatic relief valves, two per main drain sump. Contractor shall provide to the Owner a Certificate of Compliance, signed by a licensed design professional, for main drain sump(s) and frame(s) and grate(s), as required by the Virginia Graeme Baker Act.
- B. Gutter Outlet Frame and Grate (12"x12"): Lawson Aquatics #MLD-FGD-1212. Eighteen (18) required.
- C. Floor Return Inlet 1-1/2" Adjustable: StaRite #08417-0000, United Industries, or approved equal. Seventy-six (76) required.

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- D. Swimming Pool Underwater Lights: 'J & J Electronics' #F5W-120-100-P; White LED with stainless steel face rings, 87-watt lamps and LWC. Stainless steel niches, Pentair #78210600 with 1" hubs, or approved equal. Fifty-six (56) required.
- E. Junction Box for Underwater Lights, complete with strain reliefs: Hydrel #1719, Appleton, or approved equal. Twenty-eight (28) required.

SPECTRUM

## 2.04 DECK EQUIPMENT

- A. Starting Platform Anchors: SPECTRUM RECORD BREAKER #24070, 6" deep, no known equal. Twenty-five (25) required, for concrete deck. 'SPECTRUM' #153174 cover for dual wedge, 'Competitor' #23303, cover removal tool, two (2) required.
- B. Adjustable Starting Platforms: Track Start Competitor, side step #25427 no known equal. Seventeen (17) required.
- C. Stanchion Sockets: 1.91" I.D. Bronze. KDI-Paragon 38201TC, no known equal. Twenty-two (22) required.
- D. Stanchion Posts: 1.90" O.D. x .145 wall. KDI-Paragon, Twelve (12) #38106, and Twelve (12) #38301, no known equal.
- E. Lane Line Anchors: Heavy eye bolt with insert. KDI-Paragon #73017/18 or equal. Eighty (80) required.
- F. Racing Lanes: 6" Competitor #200-384 50M with 2-75 ft disc. Nine (9) total. No known equal, verify colors with Owner. Provide vinyl covered stainless steel lane line extensions, Knorr System model #EP-009-0020 or approved equal, two (2) per lane line. Provide floating water polo goal tethers, eight (8) total. Provide two (2) additional lanes to be utilized with 30M and 25M floating water polo goals as side lanes and three (3) lanes utilized for stationary water polo courses. Provide two (2) additional #200-372 75' lanes. Shop drawings required.
- G. Racing Lane Reel with Cover: KDI-Paragon #75111SS with cover #75133, no known equal. Five (5) required.
- H. Moveable Lifeguard Chair: 1.90" O.D. x .065 wall. KDI-Paragon 20302, Spectrum 20160 or equal. Four (4) required.
- I. Figure 4 Grab Rails: KDI-Paragon #30102, 1.90" O.D. x .109" wall, no known equal. Three (3) sets required.
- J. Recessed Steps, Set of 3: KDI-Paragon #3212, no known equal. Three (3) sets of three required.
- K. Cross Braced Ladders: 'Paragon' #42123, with custom 5" wide stair treads, no known equal. Three (3) required.
- L. Handrail: KDI Paragon #34203, 3 bend, 1.90" O.D. x 0.65" wall. Three (3) required.
- M. Anchor Sockets for Grab Rails, Handrails and Ladders: KDI-Paragon 28102, no known equal. Twenty-four (24) required.
- N. Stainless Steel Escutcheon Plates for Grab Rails, Handrails and Ladders: Spectrum Model #35214, no known equal. Twenty-four (24) required.
- O. Stationary Water Polo Goals: (PURCHASED BY OWNER IN FUTURE, N.I.C.) KDI-Paragon 36104, 36201, complete with nets.
- P. Floating Water Polo Goals: 'Antiwave' #AW060 or equal. Three (3) pair complete with nets and tethers.
- Q. Disabled Lift: Spectrum Traveler XRC 500 #27610 Swim-Lift II self-operated or approved equal. Furnish complete with anchors, cover, extra battery pack and transporter cart. One (1) required.
- R. Backstroke Pennants: 'Champion' 3/16" diameter vinyl coated cable #50-175; 'Champion' hardware package #53-030, and 'Champion' 12" x 18" vinyl coated polyester pennants #53-020 Lincoln Equipment, Knorr Systems or equal.

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S. Pool Cover System:

1. A pool cover system as described below shall be provided and shall include all the specified features, without exception. Submittal data must include complete documentation relating to all the specified features and include manufacturer's sales literature, specification sheets, and installation/operation/maintenance manuals. Upon written request by the specifying agent, the following samples must be provided: samples of tubing used for storage reel winding tubes and end frames; a sample winding tube bearing; a sample castor wheel assembly; and a cover sample measuring at least 8" x 11", including weighted side edge, reinforced end edge, and grommet.
2. Cover Material:

- a. Material shall be woven, 10 by 10 count per inch, high-density polyethylene, ultraviolet stabilized film fabric, laminated to both sides of 1/8" thick, closed cell, medium density, white, polyethylene foam. The woven polyethylene film fabric shall be coated on both sides with an ultraviolet stabilized, chemically resistant polyethylene coating. The combination of film, foam and woven components shall be non-toxic, non-absorbent, non-permeable and buoyant. Color shall be blue on upper surface and black on under surface. In addition to the above, cover must meet the following requirements:

Thickness	1/8 inch minus or plus 10%
Foam Density	2 lbs. per cubic foot
Weight	5 oz. per square foot
*Tensile Strength	318 lbs. (ASTM 1682264)
*Tear Strength	60 lbs. (ASTM D2261-71)
*Bursting Strength: (Mullen Tester)	425 psi (ASTM 751-73)
Service Temperature	-40°F to +160°F
K Factor	.25 BTU/sq. ft.-Hr – degrees F/inch (ASTM D2326)
Reinforced Edge Tear Strength	1225 lbs. pull strength, corner to corner
Open Seam Tear Strength	70 lbs.

3. Cover Design Criteria:

- a. Cover panels shall totally cover the surface of the pool without gaps or overlaps with reinforced cutouts to accommodate rounded corners, step areas, rails, etc. Cover panels shall be of the following quantities and sizes:

<u>Qty.</u>	<u>Size</u>
12	13 feet, 8 inch x 75 feet, 1 inch

- b. Along end and side edges of each panel, a weighted material shall be sewn in and shall be continuous, non-corrosive and conform to the flat shape of the cover. End edges shall be reinforced with a double layer of polyethylene-coated film fabric and designed in such a manner as to prevent panels from dividing when the covers are being pulled across the water. On all corners, weighted edge shall wrap corners and be itself encapsulated by the two layers of end reinforcement. The entire corner construction shall be reinforced with a 1/8" thick load dispersion plate and non-corrosive grommet.
- c. Both ends of each cover panel shall be equipped with no less than three (3) non-corrosive grommets and quick-release loops for easy connection to the storage reel or to the next cover panel. All sewing shall be ultra-violet stabilized and chemically resistant 100% polyester thread. Main body seams shall be welded, glued or heat sealed. Complete mechanical attachment with lock-stitched thread shall be required. Warning labels consistent with the recommendations of the Federal Consumer Protection Agency shall be permanently affixed to each end of each cover panel and to the sides of perimeter panels.

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4. Storage Reels:

- a. The following quantity, type, and size of storage reels shall be provided:

<u>Qty.</u>	<u>Winding Tubes Per Reel</u>	<u>Length of Winding Tubes</u>
4	3	16 Foot

- b. Storage reel frame, winding tubes, castors, brake shafts, cranks and fasteners shall be made of type 304 stainless steel. Each reel shall have six wheels, each of which shall be 6 inches in diameter, be rated at 1150 pounds load capacity and be made of solid polyurethane. Wheels shall be lubricateable through grease fittings on stainless steel axle shafts and have stainless steel swivel yoke assemblies. The reel shall have two frame mounted, screw-type brakes with pads that lock directly to the pool deck and have a total of 18 square inches of total braking surface. Castor brakes or other types of foot-operated or lever-operated brakes will not be considered equal. Each winding tube shall be 4 1/2 inches in diameter; have a wall thickness of .120 inches; and shall consist of continuous length of tubing without joints or welds. Reels with tubes fabricated from two or more pieces of tubing joined together will not be acceptable. End frames shall be fabricated from 1 1/2 inch square Schedule 304 stainless steel box beam tubing with .120" wall thickness. To facilitate field repair, 3/8" stainless steel bolts, nuts and washers shall be used to connect major reel frame parts, wheels, brakes, bearings and winding tubes. Reels that use welding to connect these components will not be considered equal. Winding tube bearings shall be heavy duty, self-aligning, pillow block ball bearings with set screws to secure tube shafts and prevent their lateral movement. All bearings shall be lubricateable through grease fittings. Plastic surface bearings will not be acceptable.
- c. Each storage reel shall be provided with a protective cover constructed of vinyl-laminated polyester cloth, 1000 denier, totaling 13 ounces per square yard.

5. Measuring and Training:

- a. A representative of the manufacturer shall visit pool site to confirm measurements prior to fabrication of cover, and once cover is delivered, train operating personnel and supervise initial installation of cover.

6. Warranty:

- a. Cover panels shall be provided with manufacturer's three- year full replacement warranty covering defects in material and workmanship. Storage reel shall be provided with manufacturer's 10-year warranty covering defects in material and workmanship.

## 2.05 SWIMMING POOL STRAINER

- A. 'MerMade' F.O. series FRP reducing basket strainer: One (1) 12" x 8" standard, with acrylic lid and two (2) stainless steel strainers each (150 lbs.)

## 2.06 SWIMMING POOL CIRCULATION PUMP

- A. 'Paco' #6015-7; 6" x 8" x 15" Type 'LC' end suction centrifugal pump; 1187 RPM 460V, 3PH; 40HP; rated at 1,930 GPM @ 60 Ft. TDH; 85% efficient; premium efficiency TEFC motor; epoxy coat all wet surfaces. 'Paco', 'Aurora' or equal. (760 lbs.) Provide smart pump control system SPCS-EKO-FLEX #SPCS040EF4 (21" x 49" x 17") variable frequency drive for use with 'BecSys 7' controller. Coordinate mounting location to maintain required clearances, 460V 3PH. (228 lbs.)

## 2.07 HIGH RATE SAND FILTRATION SYSTEM (EKO3 SYSTEMS GEN2, OR APPROVED EQUAL)

The filter system specified herein shall be the standard cataloged product of a company regularly engaged in the manufacture of water treatment equipment. The purpose of this specification is to establish the minimum design, performance, quality, and service standards for the proposed equipment. The equipment shall consist of fiberglass filter vessel(s) with internal distribution and collection system, immediate face piping, operating valves, backwash sightglass valve, air relief

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systems, gauges, hydraulic pressure supply system, electronic operational control systems, system operating setup/startup and fifteen (15) year non-prorated limited warranty.

Requests for substitutions: refer to Section 13 1106 SUBSTITUTIONS for requirements. Requests for substitutions must include, but not be limited to:

- List containing contact name and telephone number of ten like systems, each of which shall utilize all specified features and employ fiberglass filament wound vessels, and electronic filter control devices.
- Complete documentation and that proves proposed unit includes all the specified features.
- Manufacturer's sales literature.
- Engineering drawings, structural and seismic calculations prepared by a licensed Civil Engineer.
- Certification listings.
- Installation/operation/maintenance manuals.
- Name and address of the site-local, factory-authorized startup and service representative with affidavit of last date of certification.

Failure to provide this or any other information necessary to confirm that all specified features are provided will be cause for rejection of substitution request.

A. Filter Area and Flow Rate:

1. The filter system shall be of the pressure type, horizontal in its configuration, suitable for a single grade of filter media, and shall bear the listing mark of the National Sanitation Foundation (NSF) Standard 50 for a maximum flow of 20 gallons per minute per square foot of filter area.
2. The filter system shall consist of five (5) high-rate permanent media filter tanks, each with 26 square feet of filter area. The system shall have a total effective filter area of 130 square feet. When operating at 15 gallons per minute per square foot of filter area, the filter system will have a capacity of filtering 1,950 gallons per minutes.

B. Filter Vessel:

1. Vessel :
  - a. The filter vessel will be 42" inside diameter, will have 26 square feet of filter area and shall be designed for a maximum working pressure of 100 psi with a 5 to 1 safety factor for minimum burst. The design shall be capable of withstanding, without leaks or structural failure, a repetitive pressure test consisting of 250,000 cycles of 0 to 100 psi. This is required to ensure long service life, reduce potential liability and guarantee safe operation.
  - b. Each filter tank(s) shall consist of a body and two dished heads manufactured with a dual wall structure consisting of a contact molded inner structure and a filament wound outer structure. The inner structure shall be manufactured with Woven Roving and Chop Strand Mat on a male mold in a two or three-piece design, depending on length, and joined together with secondary joint(s) before applying the outer structure. The outer structure shall be filament wound in both radial and axial geometric patterns to provide maximum strength in all load directions. The dished heads and body thicknesses shall be designed according to ASME Section X requirements confirmed through calculations and a Finite Element Stress Analysis. The outer structure of the tanks shall be seamless and constructed of pigmented resin to provide a professional exterior finish.
  - c. The filter tank(s) shall be mounted on two FRP saddle supports that are permanently bonded to the tank through the use of a structural adhesive system. The tank support

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saddles shall be designed in compliance to all relevant seismic code requirements when anchored to the manufacturer's specifications.

- d. A 16" round flanged manhole, complete with FRP cover, clear acrylic viewing window, combination gasket/ O-ring and bolts shall be located in the dished head of the filter tank(s). All O-ring contact points on the manhole flange and cover shall have a smooth finish to provide a continuous watertight seal. Manways or manholes located in the side shell of the vessel will not be permitted. Manways or manholes with metal reinforcement will not be allowed, due to inherent weaknesses.
  - e. A molded 3" media dump port and separate ¾" water drain complete with a ABS media retainer shall be located on the front side shell of the filter tank(s).
  - f. A molded ¾" external air relief complete with PVC ball valve shall be located on the top side shell of the filter tank(s).
  - g. The influent and effluent ports shall be Victaulic grooved to facilitate proper connection of both internal and external piping. The influent/ effluent ports shall consist of Sch. 120 PVC designed according to NSF/ANSI Standard 50 requirements. The ports shall be molded into the top section of the shell and shall be placed in such a manner as to eliminate interference between internal components and the internal port connections. Through flanges fastened to tank side shell by means of mechanical fasteners shall not be acceptable for this application.
  - h. Following fabrication, the entire vessel shall be cured to ensure uniformity of strength.
  - i. Each filter vessel shall be subjected to an in-shop hydro pressure test of 100 psi for a period of four (4) hours. Verification of this test and results shall be available to the owners upon request.
2. Distribution and Collection System
    - a. The filter tank equipment shall include an upper distribution system and lower collection system, hydraulically balanced to prevent filter media migration during filter operation and/ or backwash.
    - b. The upper distribution system shall include hydraulic diffusers manufactured of injection molded PVC plastic, located in multiple sets of two over the filter bed. They shall be piped to a Schedule 80 PVC distribution header with PVC pipe and fittings appropriately sized to maintain proper flow velocities throughout the entire distribution system.
    - c. The lower collection system shall consist of a molded ABS header and molded ABS plastic laterals with .009" tapered slots designed to retain a single grade of filter media with a .3 mm particle size. Laterals with a flow velocity not exceeding 6 feet per second at designed filter flow rate shall be utilized. Non-molded laterals will not be considerable acceptable for this application. Collection system hydraulic design calculations shall be available upon request. The internal collection system shall be designed to promote media bed circulation during backwash while providing minimal head loss during filtration.
  3. Air Relief System
    - a. An automatic air bleed system shall be provided. An anti-plug protective shield screen shall be a part of the assembly. A manually operated external air relief shall also be provided for the vessel.
  4. Winterizing/Drain and Media Dump Port
    - a. At the lowest point of the front of the vessel a three-inch (3") port shall be provided. The port shall allow the evacuation of all water from the vessel for the purpose of winterizing or service. No media shall be allowed to leave the vessel during the draining process. The port shall also facilitate the removal of the filter media from the vessel.
- C. Each filter vessel within the system shall be cleaned individually using filtered water provided by adjacent filter vessels. Reverse flow backwash with raw source water will not be allowed.
1. Backwash Valve

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- a. One (1), two-way, three-port, six-inch (6") backwash valve shall be supplied with each vessel. The valve body shall be injection-molded of ABS plastic all external components will incorporate UV inhibitors. Valves using metal bodies and covers, coated or non-coated, will not be approved. Grooved type fittings shall be provided at each of the valve ports for connection to the filter vessel and manifold piping. Couplers shall be provided at each of the valve ports for connection to the filter vessel and manifold piping. The couplers shall be injection-molded of Isoplast 101LGF40NAT plastic and shall contain UV inhibitor. Each valve shall be fitted with a hydraulic diaphragm designed to operate a sliding flow direction piston. Valve internal shaft, nuts, washers and bolts shall be 316 stainless steel. All stainless-steel components shall be passivated and rinsed after forming and machining.
    - b. The backwash valve shall be designed to allow for continuous circulation pump operation during the backwash of the filter system that will prevent the loss of circulation pump prime and damage to boiler, chemical feed systems and piping that can result by repetitive on/off cycling of circulation pump. Valves requiring external linkage for synchronization of their operation will not be allowed.
  2. Rate of Flow / Priority Valve
    - a. System shall be provided with either an electrically actuated butterfly priority valve or manual rate of flow valve. A priority valve is required on all two and three tank systems, as well as a four-tank system operating at flow rates below 15 GPM per square feet of filter area. A rate of flow valve is required on all single tank systems, and four or more tank systems.
    - b. The priority valve shall be an electrically actuated butterfly valve supplied for use on the effluent manifold. The priority valve shall have 150psi operating pressure, one-piece body constructed and NSF 50 listed. External operating linkage valves will not be allowed.
    - c. The rate of flow valve shall be a manual butterfly valve, 150psi operating pressure, one-piece body constructed and NSF 50 listed ensuring proper system flow rate. The rate of flow valve shall be manually set during system commissioning by a factory trained technician.
  3. Backwash Sightglass Valve
    - a. A tamperproof, butterfly valve shall be supplied for use on the waste manifold. The valve shall have a 150psi operating pressure, one-piece body constructed, include a flanged connected sightglass piping system to inspect backwash flow and be NSF 50 listed. The sightglass shall be field-adjustable, ensuring proper system backwash flow rate. The backwash rate shall be manually set during system commissioning by a factory trained technician.
  4. Piping
    - a. To minimize floor space requirements and provide unhindered access to filter controls, backwash valves, media dump port, and vessel access openings, all piping shall be located on top of the horizontal filter vessel. All manifolds shall be fabricated from Schedule 80 PVC pipe and fittings. In manifold sections exceeding more than two tank lengths, additional Victaulic couplings will be supplied to join piping sections. Influent and effluent manifolds shall be 12" IPS and the waste manifold shall be 6" IPS. All piping shall be factory assembled and pressure tested.
- D. Operational Control:
  1. Automatic Backwash Control
    - a. An automatic backwash control system shall be provided (in conjunction with the automated water chemistry/mechanical room controller (refer to Section 13 11 06 2.12) which shall allow for the automatic and manual manipulation of the filter backwash operation.
    - b. The backwash control system shall include a Filter Interface Panel manufactured by BECS Technology to be installed on the filter system influent piping manifold. The

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Filter Interface Panel shall utilize sealed solenoids with 4mm orifice and ½" push fittings.

- c. The Filter Interface Panel shall include two (2) four-inch (4") pressure gauges to indicate influent and effluent pressure of the filter. The gauges shall be mounted with the solenoid block on a manufactured PVC backplate.
  - d. Differential pressure shall be calculated by the automatic backwash control system.
- E. Hardware:
1. All fasteners (nuts, bolts, washers) employed in the system shall be cadmium-plated steel.
- F. Service Access:
1. Access to manway, backwash valves, and filter control console shall be from the front of the filter system and shall not require disassembly of any piping or climbing over or around vessel, manifolds or valves to perform operation, service or routine maintenance.
- G. Filter Media:
1. Filter media depth shall be as indicated on the drawings; measurements will be taken at the site and will be from top of the collection laterals to the top of the media. The media shall be of a single grade, consisting of uniformly graded, angular shaped, crushed silica sand which shall be free of limestone or clay.
  2. Filter system manufacturer shall provide a filter media analysis for the media being utilized. Contractor shall supply manufacturer's representative with two (2) pounds of filter media from installation site. Consulting engineer, prior to its installation, must approve filter media analysis.
  3. Filter Media
    - a. #20 Sand:
      - 1) Filter media shall be Grade #20, effective size .45 millimeter with a uniformity coefficient of 1.5 maximum.

#### MEDIA ANALYSIS

Sieve No. US Series	MM Opening	Percent Retained On Sieve (By Weight)
20	0.833 (0.333 in)	2
30	0.589 (0.023 in)	58
40	0.417 (0.016 in)	36
50	0.295 (0.012 in)	4

- H. Pressure Amplification System
1. The pressure amplification system shall consist of a stainless-steel centrifugal pump, hydro-pneumatic pressure sustaining tank, adjustable pressure switch, 50 feet of 3/8-inch Nylo Seal® tubing and all necessary tubing connectors.
  2. Pump
    - a. The pump housing shall be made of stainless steel and the impeller shall be molded of Lexan®. A mechanical seal shall be provided and shall be a precision- lapped, highly- polished, carbon-ceramic stainless-steel shaft seal, ensuring drip-proof protection. The motor shall be a 1/2 HP, single phase, 60 cycle, 3450 RPM, suitable for service with filter control console. The motor shall be a NEMA 'C' face flange mounting with a drip-proof enclosure. The motor shall be equipped with sealed ball bearings. The pump shall be performance rated at 5 gallons per minute at 80 feet of head.
  3. Tank
    - a. Pressurized water shall be contained in a hydro-pneumatic steel tank that shall be lined with an epoxy coating. The tank will employ a flexing diaphragm, separating wet and dry chambers. The steel tank shall be designed for a maximum working pressure of 100 psi. Tank connection shall be 3/4" NPTM.

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4. Pressure Switch
  - a. A pressure switch shall be mounted directly to the pump motor and shall be rated for the operation of a 1-1/2 HP motor at 115 volt, single phase. The switch will allow for adjustment of cut-in and cut-out pressure.
5. Check Valve
  - a. A half-inch, spring-loaded check valve shall be supplied as part of the assembly. The check valve shall be installed on the pump suction and shall be designed to retain water pressure accumulated within the amplification system.
6. Tubing and Fittings
  - a. Fifty (50) feet of 1/2-inch Nylo Seal® tubing and all necessary tubing to pipe fittings shall be supplied for the connection of the HydroForce system to the filter system and the filter control.
7. Finish
  - a. The system shall be coated with an industrial-grade polyurethane high-gloss protective finish.
- I. Packaging
  1. To protect and safeguard filter vessel, it shall be skidded and supplied with a plastic wrapping to facilitate shipment, handling, and/or storage on job site. The plastic wrap shall also act as a protective barrier during installation. All other components shall be packaged in a manner that will ensure damage-free transportation and facilitate storage at job site.
- J. Instructions
  1. Printed and bound operating, installation and service manual with exploded parts list shall be supplied with the system described herein.
- K. Certification
  1. Certified/stamped engineering calculations and drawings will be required for the structural strength of filter vessel and seismic loading. The filter supplied must be listed by the National Sanitation Foundation (NSF) ANSI 50 for a flow rate of up to 20 gallons per minute, per square foot of filter area. Proof of National Sanitation Foundation (NSF) listings will be required.
- L. Commissioning/Start-Up, Owner Training and Annual Maintenance
  1. Local factory representation for the equipment contained herein is mandatory. A site specific, local factory certified, trained and authorized service specialist shall provide system commissioning/start-up to include adjustments to the filter system and all its controlling components, calibration and setup of the control system, and instructions to the owner/operator of the system's workings.
  2. Prior to the completion of one (1) years' service, the certified, trained and authorized manufacturer's service specialist shall visit the filter system installation site. With the owner/operator present, the service specialist shall inspect the filter system components for signs of wear/malfunction at that time. Any and all worn or malfunctioning items shall be repaired or replaced at no expense to the owner. The service specialist shall also provide a scope and proposal for continued annual preventative maintenance service should the owner choose to outsource the required annual maintenance required.
- M. Warranty
  1. A limited manufacturer warranty shall be provided covering all components of the filter system specified herein. Warranty initiates as of the date of system commissioning with the first year as unconditional to be free from defects in material and workmanship. Filter tank shell shall carry a 15-year non-prorated warranty. Filter tank internal components and backwash valves shall carry a three (3) year warranty, face piping shall carry a three (3) year warranty, and all accessories, including but not limited to valving, pressure gauges, air relief assembly and drain assembly shall carry a three (3) year warranty. Owner shall refer to manufacturer warranty document for required warranty claim procedures and/or contact manufacturer's authorized representative.

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## 2.08 POOL HEATER(S)

- A. Indirect fired pool heating package system; 'Aquas' Crest SmartTouch control condensing modulating boiler, titanium heat exchanger with CPVC connections, factory assembled skid mounted package, California code controls, 1 ½" natural gas connection, 3" water connections, 8" diameter air inlet and 8" diameter sidewall vent size, PVC vented; 1,999,999 BTU per hour input, 97% efficient. Provide ¾" cold water connection 'Lochinvar AP02000N", weight = 3,397 lbs. each. Two (2) total.

## 2.09 CHLORINE FEED SYSTEM

- A. Provide one (1) 'Chem-Tainer' 500 Gallon #TC5971DC; dual storage/containment tank with lid seismically restrained; (4,165 lbs.). Complies with Fed. Reg. #40CFR-264-163. Feed system(s) shall be 'LMI' #SD43-88P-KSI; 288 GPD @ 15 PSI with FRP shelf bracket. Hard pipe to point of injection.

## 2.10 ACID STORAGE/FEED SYSTEM

- A. Provide 'Chem-Tainer' 350 Gallon #TC5256DC; dual storage/containment tank with lid seismically restrained; (2,915 lbs). Complies with Fed. Reg. #40CFR-264-163. Feed pump shall part of the Carbon Dioxide alkalinity control system. Provide a complete acid vapor recovery system.

## 2.11 CARBON DIOXIDE STORAGE/FEED SYSTEM

- A. Provide one (1) NOVO-750, 750 lb. cryogenic liquid CO2 storage tank with remote fill port, electric tank heater and ductile seismic anchor ring. 594 liquid lbs. (5,195 cubic feet of gaseous CO2 at NTP), one (1) total. Provide EKO PH-MTS CO2 high efficiency feed system with alkalinity control, 0 to 160 SCFH capacity booster pump, piping injector, flowmeter, relays and acid feed alkalinity control. One (1) system total. (92 lbs.) Provide hard wired 'Analox Ax60+ CO2 detector with audible and visual arms in each chemical room, UL 1971 standard listed, one (1) total.

## 2.12 SWIMMING POOL WATER CHEMISTRY CONTROLLER

The equipment room controller package shall be BECS Technology model CS-BECSYS7-BP-E packaged by Eko<sup>3</sup> Systems.

- A. General
  - 1. The integrated equipment room control system shall provide continuous monitoring and control of sanitizers, oxidizers, pH, temperature, system flow rate monitoring, total dissolved solids (TDS), turbidity, chemical inventory levels, surge tank and backwash holding tank water levels, system pressures, and water chemistry balance calculations. The control system shall also provide automatic control of the filtration system including backwash operation. Installation of the system shall be per the manufacturer's specification and no exceptions shall be allowed. A factory trained/authorized representative shall provide system commissioning and training to the owner.
- B. Certifications
  - 1. The controller shall carry the following product certifications:
    - a. UL 61010-1
    - b. (CSA) C22.2 Number 61010-1
    - c. European Union Low Voltage Directive 73/23/EEC EN 61010-1
- C. Sensors
- D. The controller shall include pH, ORP, ppm and temperature sensors meeting the following requirements:
  - 1. pH sensor

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- a. The controller shall continuously monitor, display and data log pH with 0.1 or 0.01 resolution (programmable) and provide a measurement of pH by utilizing a sensor with the following characteristics:
  - 1) 0 – 14 sensing range;
  - 2) ABS body with ½" NPT process connection;
  - 3) Minimum of 32 milliliters of inorganic electrolyte gel; organic electrolytes, susceptible to breakdown in the presence of strong oxidants, shall not be considered equal;
  - 4) A porous Teflon liquid junction to provide a stable, low impedance reference contact, and to prevent fouling and clogging of the liquid junction;
  - 5) A silver/silver chloride (Ag/AgCl) reference element;
  - 6) A general purpose glass membrane pH sensing element;
  - 7) Operating temperature range of 0 - 80 degrees C;
  - 8) Operating pressure range of 0 - 100 psiG.
2. ORP / HRR sensor
  - a. The controller shall continuously monitor, display and data log ORP with 1mV resolution and provide a measurement of ORP by utilizing a sensor with the following characteristics:
    - 1) -1000 to +1000mV sensing range;
    - 2) ABS body with ½" NPT process connection;
    - 3) Minimum of 32 milliliters of inorganic electrolyte gel; organic electrolytes, susceptible to breakdown in the presence of strong oxidants, shall not be considered equal;
    - 4) A porous Teflon liquid junction to provide a stable, low impedance reference contact, and to prevent fouling and clogging of the liquid junction;
    - 5) A silver/silver chloride (Ag/AgCl) reference element;
    - 6) A solid platinum or solid gold ORP sensing element with a minimum of 1 cm2 surface area; platinum-plated and gold-plated sensing elements, which are susceptible to abrasives, shall not be considered equal;
    - 7) Operating temperature range of 0 - 80 degrees C;
    - 8) Operating pressure range of 0 - 100 psig.
3. Amperometric (ppm) Sensor
  - a. The optional Free Chlorine sensor shall be an amperometric probe system with a measuring range of 0.05 to 20 mg/l with a fully selectable scale and a temperature range of 36°-113° Fahrenheit. The amperometric probe shall come with a PVC body, replaceable PTFE membrane and electrolyte, gold cathode and silver/ silver chloride anode.
4. Temperature Sensor
  - a. The controller shall continuously monitor, display and data log temperature with 1°F resolution and provide a measurement of water temperature by utilizing a sensor with the following characteristics:
    - 1) 32 – 212°F (0 – 100°C) sensing range;
    - 2) 2 wire, 100Ω resistive temperature detector (RTD) with an 0.00385 Alpha.
5. Flow Sensor
  - a. The controller shall continuously monitor, display and data log flow rate with 0.1 gpm resolution and shall provide a measurement of pool circulation flow rate and volume by utilizing a flow sensor with the following characteristics:
    - 1) 0-8800 gpm (0-33265 liter/min) measuring range,
    - 2) Paddle wheel flow sensor with a frequency output,
    - 3) Dual O-ring seal,
    - 4) 25 foot cable,
    - 5) Iron pipe saddle,

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- 6) Flow volume: 999 trillion gallons, 1 gallon resolution; 999 trillion liters, 1 liter resolution.
6. 4-20mA Sensor
  - a. The controller shall be capable of reading a total of eight (8) 4-20mA output sensors, including the following:
    - 1) Pressure Transducers (Quantity 2)
    - 2) The controller shall continuously monitor, display and data log pressure(s) with 1 psiG resolution and provide measurement of filter influent and/or filter effluent pressure by utilizing pressure transducer(s) with the following characteristics:
      - (a) 0 to 100 psiG measuring range,
      - (b)  $< \pm 2\%$  span max @ 25° C which includes linearity, hysteresis and repeatability,
      - (c) 0.25% static error band and 1.5% typical thermal error band,
      - (d) Temperature compensated and fully calibrated,
      - (e) Stainless steel wetted components with plumbing connections of 1/4".
    - 3) Vacuum Transducer (Quantity 1)
    - 4) The controller shall continuously monitor, display and data log vacuum(s) with 1 psiG resolution and provide measurement of strainer vacuum by utilizing a vacuum transducer with the following characteristics:
      - (a) -15 to +85 psiG measuring range,
      - (b)  $< \pm 2\%$  span max @ 25° C which includes linearity, hysteresis and repeatability,
      - (c) 0.25% static error band and 1.5% typical thermal error band,
      - (d) Temperature compensated and fully calibrated,
      - (e) Stainless steel wetted components with plumbing connections of 1/4".
    - 5) Liquid Level Sensors - Three (3) total
    - 6) The controller shall provide measurement of liquid levels for surge tanks, backwash holding tanks and/or liquid chemical inventory by utilizing liquid level sensor(s) with the following characteristics:
      - (a) Field configurable sensing range from 3 ft to 16 ft,
      - (b) Field calibration for various tank levels, shapes and sizes,
      - (c) Non-contacting sensing elements enclosed in PVC.
    - 7) Conductivity/TDS Sensor
    - 8) The controller shall continuously monitor, display and data log conductivity/TDS with 1 micromho/ppm resolution and provide a measurement of conductivity/TDS by utilizing a sensor with the following characteristics:
      - (a) 0-20,000 micromhos (0-10,000 ppm TDS) measuring range
      - (b) A 316 stainless steel electrode,
      - (c) PTFE insulator as well as a dual EPR O-ring seals,
      - (d) AC operation, which resists electrode plating.
- E. User Interface
  1. Standard Display
  2. The standard display shall be a backlit transfective LCD with 14 line x 40 alpha/numeric graphical characters that will continuously display information related to the following:
    - a. All installed sensor readings,
    - b. Set points, with current control status,
    - c. All active alarms, including time activated,
    - d. Smart menus w/ integrated on-screen help.
  3. Contrast adjustment of the backlit LCD shall be provided through clearly marked keys on the front-panel without the need for access to internal controller circuitry. After initial adjustment, controller shall monitor internal temperature and automatically adjust contrast to prevent LCD blackout in extreme ambient temperature conditions. Controllers that do

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not include front-panel contrast adjustment and automatic temperature compensation shall not be considered equal.

4. The standard user interface shall include single-touch access to Set Points, Relay Modes, Calibrations, Backwash status and settings, Menu access, and Reset Fail/Safes. An alphanumeric keypad shall be provided for ease of system configuration.

#### F. Control Functions

##### 1. Water Chemistry

- a. pH Control: The controller shall continuously control pH. Chemical feed shall be configurable for feed-up, feed-down, or dual feed and either on/off or time-based proportional feed.
- b. Sanitizer Control: The controller shall continuously control sanitizer based upon the ORP reading, the amperometric sensor, or both with a bracketed control program. Chemical feed shall be configurable for either on/off or time-based proportional feed.
- c. Bracketed Sanitizer Control: With the amperometric ppm sensor, the controller shall be configurable for bracketed sanitizer control; The bracketed control algorithm shall allow either the ORP or ppm setpoint to be chosen as the primary control point, while using other parameter to create a secondary boundary (min and max settings) that must be maintained in addition to the primary control point.
- d. Sanitizer Booster Feed: The controller shall have a sanitizer booster program with selectable ORP and/or ppm set points with separate ending set points, allowing the option of the booster sanitizer to control to a lower set point while the primary system can recovers.
- e. Ozone/UV Control: The controller shall provide feed-up control of an ozone or UV system based upon ORP and/or ppm set points. A Fireman Cycle feature shall turn off the Ozone/UV relay 0 to 60 minutes (settable) prior to backwash initiation or recirculation pump shutdown. The Ozone/UV control algorithm shall include an Energy Conservation mode, with on/off set time and secondary set point.
- f. Superchlorination: The controller shall have a programmable superchlorination function, based ORP or ppm superchlor setpoint, which is triggered manually.
- g. Dechlorination: The controller shall have a programmable dechlorination function, based upon ORP or ppm dechlor setpoint, which is triggered either manually or by the completion of the superchlorination function.
- h. LSI & RSI: The controller shall compute the Langelier Saturation Index and the Ryznar Saturation Index based upon current inputs and the Ca Hardness and Alkalinity entered by the operator.
- i. Flow Monitoring: The controller shall continuously monitor, display, and data log system flow, maintaining a total flow volume. A low flow alarm shall be operator settable, which can be programmed to disable chemical feeds.
- j. Heater Control: The controller shall perform on/off control of a heater based upon an operator settable temperature set point. A Fireman Cycle feature shall turn off the heater 0 to 60 minutes (settable) prior to recirculation pump shutdown. Heater control algorithm shall include an Energy Conservation mode, with on/off set time and secondary temperature set point.
- k. Chemical Inventory Monitoring: The controller shall continuously monitor, display, and data log liquid pH adjuster and sanitizer inventory levels. The controller shall include low chemical level alarm points for each chemical being monitored.
- l. Backwash tank Monitoring: The controller shall continuously monitor, display, and data log backwash holding tank levels.
- m. Surge tank Monitoring: The controller shall continuously monitor, display, and data log surge tank levels.
- n. Autofill: The controller shall automatically control a water makeup relay to add makeup water to maintain pool level set point, based upon surge tanks (or equivalent) level, with an overflow delay feature. The controller shall provide a

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programmable alternate set point (4 event 28 day timer). Use in conjunction with 3" valve specified in Section 13 1107, 2.03G

- o. Sensor Wash: The controller shall include a programmable sensor wash with start and end time, feed duration, and number of cycle to allow multiple feed cycles per day.

#### G. Energy Conservation

1. Alternate Setpoints: The controller shall have alternate Sanitizer, Heater, and Autofill setpoints, based upon a 4 event 28 day timer.
2. Energy Conservation Mode: The controller shall have the capability to disable all mechanical and chemical functions during programmed conservation cycle. The Energy Conservation Mode shall include the ability to periodically monitor and satisfy all operation requirements based upon a programmed time schedule.

#### H. Automatic Backwash

1. Backwash Initiation: The controller shall be user configurable to initiate backwash upon any of the following conditions:
  - a. Time, based upon a 24 hour, 7 day programmable calendar,
  - b. Pressure Differential, taken from either a pressure differential switch or an operator settable low pressure differential setpoint based upon the differential between two installed pressure transducers,
  - c. Low System Flow, an operator settable low flow set point based upon the installed system flow meter,
  - d. Totalized filter water volume, an operator settable totalized filter water volume set point based upon the total system flow maintained by the controller from the installed system flow meter,
  - e. High filter effluent turbidity, an operator settable turbidity set point based upon the installed turbidity sensor,
  - f. Manual, which only initiates backwash when manually activated by operator.
2. Normal Operation: The controller shall be capable of controlling the backwash operation of up to 16 filters, with the following backwash features included as part of normal programming.
  - a. Inhibit Period, Operator settable daily time period during which backwash is prevented from being triggered.
  - b. Backwash Frequency Fail Safe: Prevents an automatically triggered backwash from starting within this time period from the end of the previous backwash. Does not prevent a Manual initiation of backwash.
  - c. Fireman Cycles: The controller shall provide operator settable independent Fireman Cycle settings for the Heater and Ozone/UV controls. The controller shall automatically delay the start of the backwash operation until the Heater and Ozone/UV controls have been deactivated and the corresponding Fireman Cycles have expired.
  - d. Primary/Priority Valve Management: Primary/Priority valve control closes a Primary/Priority valve during backwash of a filter to increase the flow through the filter being backwashed.
  - e. Alternate Lead Filter, In multiple filter systems, the controller shall automatically alternate the lead filter in each successive backwash cycle, in order to assure an effective full backwash of all filters in the system.
  - f. Backwash duration: Operator settable length of time to backwash each filter.
  - g. Dwell Time: Operator settable length of time to delay after each filter is backwashed.
3. Backwash Holding Tank Management: The controller shall be capable of monitoring the backwash holding tank to prevent overflow, by adjusting the backwash cycle as follows:
  - a. Suspend backwash when the holding tank is full, allowing time for the holding tank to drain.
  - b. Automatically resume backwash when the holding tank is empty.

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- c. An operator settable timeout which monitors the amount of time the backwash holding tank takes to drain. If this timeout is exceeded, a limit timer alarm is activated and the backwash cycle cancelled.
  - 4. Advanced Backwash Optimization: The controller shall be capable of the following advanced features as part of the normal backwash programming:
    - a. Backwash accessory: Turns on an additional relay before, during, and/or after backwash operations based upon operator settable parameters; useful for sites where application of a dechlorination agent to backwash water (holding tank) is required.
    - b. Water Saving (Turbidity): The controller shall be capable of monitoring backwash effluent turbidity and ending a filter backwash early upon reaching a desired turbidity set point.
    - c. Filter Isolation: During backwash suspension due to full backwash holding tank, allows suspended filter to be isolated from the system rather than being returned to filter mode. This prevents the filter bed from recompacting, making the resumed backwash rapidly effective. Requires properly equipped filters.
- I. Main Recirculation Pump
  - 1. On/Off Control with Relay:
  - 2. Controller shall provide the capability to interface to and control a recirculation pump with a programmable relay. The controller shall include the following capabilities, available as appropriate based upon installed sensors and implemented features:
    - a. Fireman Switch: The following events shall satisfy Fireman Switch timing requirements prior to turning off recirculation pump:
      - 1) Backwash Operations
      - 2) Energy Conservation mode (24 hr, 7 day function)
      - 3) Manual off
    - b. Immediate: The following events immediately turn off recirculation pump, regardless of Fireman Switch timing requirements:
      - 1) Surge Tank Level Low Alarm: Turn off pump immediately (surge tank is almost empty)
      - 2) Strainer Vacuum High Alarm: Turn off pump immediately (possible entrapment)
      - 3) Emergency shutdown, triggered by front-panel Emergency Off: Turn off pump immediately (per Operator)
- J. Total Dynamic Head (TDH)
  - 1. Controller shall provide the capability to continuously monitor the Total Dynamic Head (TDH) of the main recirculation pump, directly calculated by the controller from recirculation pump influent vacuum and filter influent pressure transducers. TDH shall be displayed on the user interface and recorded in data logs, with user-programmable High and Low TDH Alarm settings.
- K. Control Outputs
  - 1. Relay Outputs - Solid-State Relays:
  - 2. The controller shall come with a total of 4 integral line or dry contact 5A solid-state relay outputs capable of switching 3A under all normal operating conditions, accounting for the effects of the temperature gradient inside the NEMA 4X enclosure. Systems that utilize relays that are not de-rated must submit an engineering evaluation justifying the use of relays at their full, optimal-condition capacity.
  - 3. Mechanical Relays
  - 4. The controller shall come with a total of 3 mechanical relays:
    - a. 1 integral 8A dry contact mechanical relay, and
    - b. 4 integral 3A dry contact or line powered mechanical relays.
    - c. Since mechanical relays have the inherent risk of failing in the closed (active) position, as a safety measure the controller shall preclude the ability to assign any of

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the integral mechanical relays to chemical feed functions. Systems that do not preclude mechanical relays from being configured for chemical feeds shall not be considered equal.

5. Expansion Relay Outputs
  - a. The controller shall be capable of expanding the number of relay outputs available by adding up to 3 expansion modules in any combination.
- L. Solid-State Relay Expansion Modules
  1. Each Solid-State Relay Expansion Module provides 5 integral 5A solid state dry contact or line powered relays capable of switching 3A under all normal operating conditions. Systems that utilize relays that are not de-rated must submit an engineering evaluation justifying the use of relays at their full, optimal-condition capacity.
- M. Mechanical Relay Expansion Modules
  1. Each Mechanical Relay Expansion Module provides 5 integral mechanical relays:
    - a. 1 integral 8A dry contact mechanical relay, and
    - b. 4 integral 3A dry contact or line powered mechanical relays.
    - c. Since mechanical relays have the inherent risk of failing in the closed (active) position, as a safety measure the controller shall preclude the ability to assign any of the integral mechanical relays to chemical feed functions. Systems that do not preclude mechanical relays from being configured for chemical feeds shall not be considered equal.
- N. Safety Features
  1. Manual-On limit
    - a. The controller shall have built-in limits to the amount of time any relay control output may be forced on (i.e. in "Manual On" mode). This is an important safety feature to prevent control outputs from inadvertently being left forced on after service or diagnostics.
  2. High/Low Alarm Settings & Control Lockouts
    - a. The controller shall have programmable high and low alarm settings for pH, ORP, PPM, temperature, low flow & no flow and chemical overfeed, turbidity, pressure & vacuum, surge tank levels, chemical inventory.
    - b. The controller shall have a programmable lockout of sanitizer feed upon pH high or low alarm.
  3. No Flow Alarm & Flow Restored Delay
    - a. The controller shall activate a No Flow alarm when the dedicated sample stream flow switch indicates there is insufficient flow through the sample stream. This No Flow alarm shall lockout all chemical feed control operations.
    - b. The controller shall include a Flow Restored Delay, which shall extend the No Flow lockout user-programmable amount of time after the No Flow alarm ends (i.e. flow is restored). This feature is necessary to assure that the system has valid, stable sensor readings of circulating water prior to making chemical feed control decisions.
    - c. Feed Limit Alarms
    - d. The controller shall trigger a Failsafe alarm if a chemical feed relay remains on longer than the programmable Feed Limit Timer. Chemical feeds shall automatically be disabled if the corresponding reading goes into a Failsafe alarm condition.
  4. Emergency Off
    - a. The controller shall have a dedicated Emergency Off button on the front panel of the system, which immediately halts all chemical feeds and control outputs when pressed. This feature shall be password protectable, which shall require entry of one of the Security passwords.
  5. Safety Shield
    - a. The controller shall include a safety shield or other mechanism for allowing fuse replacement without access to high voltage circuitry or wiring.

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- O. Security
  - 1. The controller shall have three security password levels: six for operators, two for managers and one for the distributor providing for a history of access identified by the user.
- P. Data Logging
  - 1. The controller shall have 512K battery backed-up RAM for input level recording and events. All input level shall be recorded for 10 to 56 days depending on sample rate (2to 10 minutes).
  - 2. The controller shall record and maintain the latest 1100 events over a maximum of 14 days recording all alarms, parameter changes, user logins, and operational cycles related to all control features
- Q. Local Alarms / Indicators
  - 1. The controller shall signal all alarm conditions with the following indicators:
    - a. A bright red flashing LED on the front of the controller,
    - b. Activation of a master alarm signal provided as a dry contact relay enabling the use of 0-240 VAC alarms, and each active alarm listed on the LCD display along with time activated.
- R. Remote Communication, Access and Alarm Notification
  - 1. Ethernet
    - a. The controller shall come with a standard, integral 100BaseT Ethernet connection. The controller shall be capable of providing Remote Access via PC with Ethernet connection and Alarm Notification via email or text message via an Ethernet connection to the Internet.
- S. Enclosure
  - 1. The controller shall be housed in a NEMA 4X polycarbonate enclosure.
- T. Flow Cell
  - 1. PVC flow cell
    - a. The flowcell shall have a PVC body with two ½“ NPT ports for pH and ORP sensors, two ¼“NPT ports for temperature sensor and sensor wash acid injection, and a clear acrylic front viewing window. The flowcell design shall provide precise sample flow rate and water velocity regulation past the probes. The flowcell shall come provided with PVC ½” isolation ball valves, PVC ¼” wet test valve and standard reed or optional rotary flow switch.
    - b. Each flowcell shall be equipped with a pressure-sensing device. The pressure sensor shall consist of a compound pressure/vacuum gauge manufactured in stainless steel, 2 ½” diameter, liquid filled with an operating pressure range of 0 to 60 psig and vacuum of 0 to –30 in./ Hg.
- U. Packaged System Enclosure
  - 1. The equipment room controller and flowcell with sensors shall be mounted onto a 3/8” thick PVC backplate. The flowcell shall be completely assembled and reading for integration into the plumbing.
- V. AC Surge Suppression
  - 1. An integrated solid state devise shall be furnished to protect each mechanical room control system from excessive line voltage at controller.
  - 2. Device shall be housed in a tamper proof enclosure provided with mounting tabs and have ½” NPT hardwire connection, with LED indicator light, UL listed.
- W. Commissioning / Start-Up, Warranty and Manuals
  - 1. Controller and sensing probes (ORP, pH, ppm) shall be covered by a standard manufacturer's 5 year warranty. Manufacturer's representative shall provide a complete set of new probes on the fifth year of operation.

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2. The control system shall be provided with on-site start-up, on-site operator training, and 2 years on-site warranty service performed by a factory trained and certified representative of the controller manufacturer.
3. Manufacturer's representative shall supply an Operator's Manual describing system features and operating instructions.

### **PART 3 EXECUTION**

#### **3.01 SURFACE CONDITIONS**

- A. Inspection:
  1. Prior to installing the items of this Section, carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation may properly commence.
  2. Verify that the swimming pool equipment items may be installed in strict accordance with original design, pertinent codes and regulations, and the manufacturers' recommendations.
- B. Discrepancies:
  1. In the event of discrepancy, immediately notify the Owner's Representative's Representative.
  2. Do not proceed with installation in areas of discrepancy until all such discrepancies are fully resolved.
  3. Failure to notify the Owner's Representative's Representative and give written notice of discrepancies shall constitute acceptance by the Installer of existing conditions as fit and proper to receive its Work.

#### **3.02 INSTALLATION**

- A. Supply and install items of swimming pool equipment in strict accordance with applicable codes and regulations, the original design, and the manufacturer's published recommendations, anchoring firmly and securely for long life under hard use.
- B. Coordinate with other trades to insure all imbedded items are set plumb and flush. Railing ends must have anchor sockets and escutcheon plates. Be certain that deck equipment and railings are properly bonded prior to imbedding.
- C. All equipment shall be braced and/or anchored to resist a horizontal force acting in any direction using the criteria shown on the Drawings.

#### **3.03 INSTRUCTION**

- A. The Contractor shall provide a factory certified representative(s) to start-up and certify proper installation, operation and full warranty status of all swimming pool mechanical equipment. The Contractor shall provide not less than two 8-hour days of on-site training for facility staff in the operation and maintenance of the swimming pool mechanical equipment and systems. The two 8-hour days shall be separated by a minimum of seven calendar days and be completed within the 14-day start-up period.

#### **3.04 EQUIPMENT ACTIVATION**

- A. All water chemistry and filtration mechanical equipment shall be operational upon filling of pool after plaster. Chemicals and other related support items as supplied by Contractor, shall be in supply at start-up.
- B. For the first fourteen (14) calendar days after completion of the pool plaster, brush all plastered surfaces at least twice a day and coordinate with General Contractor to ensure that the plaster is carefully maintained after the initial fourteen-day period. In addition, coordinate with the Contractor to ensure that pool filtration equipment is continuously running during the initial fourteen-day period.
- C. Start-up and provide qualified personnel to operate pool equipment for a period not less than fourteen (14) days after the pool is placed in operation, or until the Owner takes occupancy of

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the facility or letter of substantial completion. During this time, Contractor shall instruct and supervise the Owner's personnel in the various operating and maintenance techniques involved. Contractor shall be responsible for supply of chemicals during this not less than fourteen (14) day period and at time of turnover to Owner, chemical storage tanks shall be full. (Owner's personnel shall be fully trained and capable of assuming swimming pool maintenance tasks, training may begin before Owner takes occupancy).

### **3.05 CLEAN-UP**

- A. Upon completion of swimming pool equipment, remove all debris, materials and equipment occasioned by this Work to the approval of the Owner's Representative.

**END OF SECTION 13 1106**

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## SECTION 13 1107 SWIMMING POOL MECHANICAL

### PART 1 GENERAL

#### 1.01 WORK INCLUDED

- A. Swimming pool mechanical piping as indicated on the Drawings for circulation and filtration systems, pool water heating systems, chemical control systems, booster pump systems and appurtenances.
- B. Domestic water system from points of connection within swimming pool mechanical equipment room to make-up water system.
- C. Filter backwash piping to point of connection with backwash retention pit as required.

#### 1.02 QUALITY ASSURANCE

- A. Qualifications of Workers:
  - 1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
  - 2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years experience with the materials and methods specified.
  - 3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.
- B. Standards:
  - 1. All equipment supplied or work performed shall comply with Chapter 31B of California Building Code, latest edition.
  - 2. Work shall be performed in accordance with the applicable editions of all National, State and local codes, laws, regulations and ordinances, including the following:
    - a. American National Standards Institute (ANSI).
    - b. American Society for Testing Materials (ASTM).
    - c. American Waterworks Association (AWWA).
    - d. American Welding Society (AWS).
  - 3. Do not construe anything in the Drawings or Specifications to permit Work not conforming to these requirements.

#### 1.03 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in conformance with the requirements of Section 01 3300.
- B. Required submittals include:
  - 1. Pipe and Fittings as specified in Article 2.02 of this Section.
  - 2. Valves as specified in Article 2.03 of this Section.
  - 3. Pressure / Vacuum Gauges as specified in Article 2.04 of this Section.
  - 4. Pipe Hangers and Supports as specified in Article 2.05 of this Section.
  - 5. Sleeves and Waterstops as specified in Article 2.06 of this Section.
- C. Submit proof of qualifications as specified in Article 1.03.A of this Section.

#### 1.04 PRODUCT HANDLING

- A. Delivery: Deliver all materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.
- B. Storage: Store all materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project site.

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- C. Protection: Use all means necessary to protect swimming pool mechanical items before, during and after installation and to protect the installed Work specified in other Sections.
- D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner's Representative and at no additional cost to the Owner.

## 1.05 JOB CONDITIONS

- A. Cooperate with entities performing Work specified in other Sections to so that no conflict of new construction or occupied space may occur. Should any installation Work be done without such craft coordination, that Work so installed shall be removed and re-installed.

## PART 2 PRODUCTS

### 2.01 PRODUCT QUALITY

- A. Materials and equipment shall be new, of the best quality for the purpose intended, and shall be clearly marked with the manufacturer's name and nameplate data or stamp and rating. As far as practicable, materials and equipment shall be of one manufacturer.

### 2.02 PIPE AND FITTINGS

- A. PVC Schedule 40: Type 1, normal impact, NSF approved for solvent welding applications, ASTM Specification D-1785, color shall be white. Dura, Lasco, or approved equal.
- B. PVC Schedule 80: Type 1, normal impact, NSF approved for solvent welding applications, ASTM Specification D-1785, color shall be gray. Dura, Lasco, or approved equal.
- C. CPVC Schedule 80 Influent/Effluent Piping: Type 1, normal impact, NSF approved for solvent welding applications, ASTM Specification D-1785, color shall be gray. Dura, Lasco, or approved equal.
- D. PVC DR25: Conforming to ASTM D-1784, use with epoxy coated bell and spigot-type fittings or epoxy coated mechanical joint by flange adapters with epoxy coated cast iron fittings as specified in Article 2.02 (F), below. Johns-Manville "Big Blue", Diamond Plastics, or approved equal.
- E. Copper Tubing: ASTM Specification B-88, hard drawn, with ANSI Standard B16.22 wrought copper fittings.
- F. Steel: ASTM Specification A-120, Schedule 40 black or galvanized pipe with ASTM A-47 150 lb. banded malleable iron threaded fittings.
- G. Cast Iron: ASTM Specification B16.1, cast iron flanged fittings, provide epoxy coating as required for use with chlorinated water.

### 2.03 VALVES

- A. Ball Valves:
  - 1. For pool system: True-Union design, PTFE seat material with FPM or FKM Double O-ring stem seals, locking handle, NSF certified. PVC schedule 80 body for below grade installation. PVC Schedule 80 body for above grade installation. Furnish ball valves on all pipe diameters 2½" or less with a rating of at least 200psi at 73°F. Asahi, Ipex, or Nibco.
  - 2. For copper pipe system: 3-piece full-port Bronze body valve with Teflon seat, 'Apollo', 'Nibco' or approved equal.
- B. Butterfly Valves:
  - 1. Epoxy coated cast or ductile iron body, 316 stainless steel disc and stem, viton seat material, furnish hand wheel/gear operators on all valves 8" and larger. DeZurick, Keystone, Ipex or equal.
  - 2. PVC body, PVC disc and EPDM construction suitable for chlorinated water applications. Stem shall be of 316 stainless steel and non-wetted. Valves shall be self-gasketed design with a convex sealing arrangement. Valves 1-1/2" – 10" shall be rated to 150 psi and 12" valves shall be rated to 100 psi at 70°F. Asahi Pool-Pro, no known equal.

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- C. Check Valves: Wafer-type, epoxy coated cast or ductile iron body, 316 stainless steel plates and shaft, viton seat material. Centerline, Metraflex, or approved equal.
- D. Surge Chamber Float Valve: EPD #2-0020-231 Float Control Valve, 12" line size, as manufactured by Environmental Products Division of Doughboy Recreational, Rancho Cucamonga, CA, no known equal.
- E. Surge Chamber Isolation Valve: Butterfly valve, tapped lug style, bronze body, stainless steel stem, bronze disc, phenolic back-up ring, EPT seat material. Provide stainless steel shaft extension, shaft housing and tool operator located 2'-0" above floor level with deck access grate as required. DeZurick, Keystone, Asahi, Spears, or Ipex or approved equal.
- F. RP Backflow Preventer: Febco #835-B for 2" and smaller; #825 for 2-1/2" and larger. Febco, Watts, or approved equal.
- G. Make-up Water Control: 3" 'Cla-Val' fill system to include 3" 'Cla-Val' solenoid control valve #136-01BY, 3" ductile iron, epoxy coated body with cast iron disc retainer and diaphragm washer, bronze trim, flanged globe pattern, 120V at 60 Hz. Solenoid wiring shall be wired to water chemistry controller. Provide 6" air gap at fill point.

#### **2.04 PRESSURE / VACUUM GAUGES**

- A. Furnish and install pressure and vacuum gauges on the discharge and suction sides of all pumps. 2" or 2 1/2" dial, bottom connection, chrome ring, shut-off cock and snubber. Ranges shall be selected to indicate between mid-point and two-thirds of maximum range under design conditions. Marsh, Terice, or approved equal.

#### **2.05 PIPE HANGERS AND SUPPORTS**

- A. General:
  - 1. The requirements of this Section relates to various requirements of the Agreement, General and Supplementary Conditions, Specifications, Drawings, and modifying documents which are part of the Construction Contract. Responsibility for coordination of all such applicable requirements will be that of the Contractor.
- B. Description:
  - 1. This section provides guidelines and limitations for the support of all mechanical, electrical, plumbing or architectural items from the building structure, and for the seismic bracing of such items.
  - 2. Design and install all support and bracing systems as required for the swimming pool systems. Provide for attachment to portions of the building structure capable of bearing the loads imposed. Design these systems to not overstress the building structure.
- C. Quality Assurance:
  - 1. Design and install all support systems to comply with the requirements of the California Building Code, Chapter 16A.
  - 2. Seismic bracing is to be designed by a professional engineer licensed in the State of California.
  - 3. For the seismic bracing of mechanical, electrical and plumbing system, refer to "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems" by Sheet Metal and Air conditioning Contractors National Association, Inc., (SMACNA) for guidelines.
- D. Submittals:
  - 1. Submit shop drawings for all substructures and attachment methods.
  - 2. Submit proposed alternative methods of attachment for review and approval by the Architects, prior to deviating from the requirements given below.
  - 3. For all pipe hangers and support systems, submit structural calculations and details which include all resultant forces applied to the building structure and are prepared and signed by the Contractor's licensed California professional engineer. Calculations will be reviewed for compliance with design criteria, not for arithmetic.

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E. Materials:

1. Use Kin-Line, Grinnel, or approved equal.
2. Support all pipelines individually with hangers, each branch having at least one hanger. Lateral brace as noted and required.
3. Support piping near floor with steel stanchions welded to end plates secured to pipe and floor.
4. Support vertical piping at each floor level. Install coupling in piping at each support. Coupling shall rest on and transmit load to support. Isolate copper from steel supports with vinyl electrician's tape around pipe and coupling.
5. Use Stoneman "Trisolator," Unistrut, or approved equal, isolators at each hanger and other support points on bare copper tubing system.
6. For PVC pipe, space hangers four (4) feet apart for pipe sizes 1" and under, five (5) feet apart for pipe sizes 1-1/4" to 2", and six (6) feet apart for pipe sizes over 2". Space hangers for horizontal pipes at a maximum of six (6) feet for copper 2" and smaller and for steel 1-1/4" and smaller; ten (10) feet for copper 2-1/2" and larger and for steel 1-1/2" and larger.
7. Size hanger rods, screws, bolts, nuts, etc., according to manufacturer's sizing charts.
8. Trapeze hangers may be used for parallel lines.
9. Use galvanized or cadmium plated hangers, attachments, rods, nuts, bolts, and other accessories in pool mechanical room, high humidity areas, or where exposed to weather. Hot dip galvanize all items which are not factory furnished. Plating for hinged movements must be done at the factory.
10. Lateral Bracing: To prevent swaying of the piping systems, provide angle iron bracing and anchor into wall or overhead framing. Piping shall be braced or anchored in such a way as to resist a horizontal force of 50% of its operating weight in any direction.
11. Do not use wire or other makeshift devices for hangers.
12. Furnish all substructures and fasteners required to comply with the limitations given below. Use material as specified in the various sections and as appropriate to their use.

F. Guidelines & Limitations:

1. Each Contractor will coordinate the load requirements from all subcontractors so that no combination of loads overstresses the building structure or exceed the limitations given below.
2. Concrete Structure:
  - a. Support all loads hung from concrete structure with cast-in-place inserts, unless drilled-in anchors are specifically approved in writing prior to placing the concrete.
  - b. Concrete anchors must not penetrate into reinforcing bars. Where the anchors boring indicates the presence of reinforcing bar, patch hole with an epoxy type grout and relocate anchor 12 diameters away.
  - c. Individual expansion anchors cannot support any loads greater than 300 pounds or manufacturer's specified load capacity without approval.
3. Steel Structure:
  - a. Hang no more than 20 pounds per metal deck rib in any span.
  - b. At beams, hang all beam loads greater than 40 pounds concentric to beam, not off the flanges.
  - c. Attached no loads to the beams or girders greater than the following without specific approval from the architect;
    - 1) Roof beams and girders: 300 pound point load or 600 pound total load for a single span.

G. Seismic Bracing:

1. Design and install seismic bracing to not ground out vibration and sound isolation systems.

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2. All items of mechanical and electrical equipment 60" or more in height are to be seismically braced whether such bracing is shown or not.

## **2.06 SLEEVES AND WATERSTOPS**

- A. Provide sleeves where work of this Section passes through fire rated partitions, floors and ceilings, concrete slabs or exterior of structure. Caulk clearance space using sealant appropriate for application in conformance with manufacturer's recommendations and Title 24 of California Code of Regulations. 3m, Dow Corning, or approved equal. In lieu of sleeves and caulking, "Link Seal" products may be used.
- B. Provide prefabricated waterstops as indicated on the Drawings at all pipe penetrations through structures containing stored water (i.e., swimming pools, balance/surge tanks, etc.) to insure leak-proof seals.

## **PART 3 EXECUTION**

### **3.01 SURFACE CONDITIONS**

- A. Inspection:
  1. Prior to Work of this Section, carefully inspect the installed Work of other trades and verify that such work is complete to the point where this installation may properly commence.
  2. Verify that items of this Section may be installed in accordance with the original design and referenced standards.
- B. Discrepancies:
  1. In the event of discrepancy, immediately notify the Owner's Representative.
  2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
  3. Failure to notify the Owner's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive his work.

### **3.02 ABBREVIATIONS AND SYMBOLS**

- A. Abbreviations and symbols on the Drawings are those most commonly used. Obtain clarification from the Owner's Representative on any questionable items before bid.

### **3.03 GENERAL PIPING REQUIREMENTS**

- A. Size any section of pipe for which size is not indicated or any intermediate section erroneously shown undersized the same size as the largest pipe connecting to it. Sizes listed are nominal.
- B. Cut pipe accurately to job measurements and install without springing or forcing, true to line and grade, generally square with building and/or structures and adequately supported to prevent undue stress on pipe, fittings and accessories.
- C. Make changes of direction with manufactured fittings. Street ells, bushings, reducing flanges, close nipples or bending of pipe is not allowed.
- D. Use great care to install piping in accordance with best practice. Plastic pipe shall be "snaked" in trenches to allow for thermal expansion.
- E. All above grade, below grade and buried or imbedded PVC shall be installed using solvent weld fittings. Also, each and every fitting and pipe end shall be prepared with solvent primer. Fittings shall be joined individually and with enough time between assembly of adjacent joints to allow them to seal solidly. After joining, an even ring of primer must be visible around the entire fitting. If any fittings are installed without visible primer, the fitting shall be removed and discarded and piping recut, rechamfered and joint made up again using a new fitting. All procedures, methods and techniques used to make up solvent weld joints shall be in strict accordance with manufacturer's recommendations.
- F. Arrange pipe and hangers to allow for expansion, contraction and structural settlement. No pipe shall contact structure except penetrations as shown on the Drawings.

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- G. Provide dielectric connections between copper and dissimilar metals. In copper systems, threaded piping Including connections to equipment shall be brass pipe and fittings. Install dielectric connections in vertical sections of piping only.
- H. Run pipe full size through shut-off valves, balancing valves, etc. Change pipe size within three (3) pipe diameters of final connection to control valves, fixtures and other equipment.
- I. Provide unions or flanges at connections to equipment, on service side of valves and elsewhere as required to facilitate ease of maintenance.
- J. Locate equipment shut-off valves as close to equipment as possible maintaining easy valve access.
- K. Make all connections between domestic water systems and equipment or face piping with approved backflow prevention devices as required.
- L. All PVC pipe exposed to direct sunlight shall be painted with two coats of Exterior Acrylic Semi-gloss Paint, Sherwin Williams or equal. Color to be selected by the Architect. Prior to painting the PVC pipes, the exterior of all PVC pipes shall be wiped with Methyl Ethyl Ketone, or an approved equal, to remove the glaze from the pipes.
- M. The Main Drain pipe must run either level or uphill from the main drain sump, through the surge pit (if applicable) and then to the circulation pump.

### **3.04 TRENCH EXCAVATION AND BACKFILL**

- A. Excavation:
  - 1. Excavate and backfill trenches as required for the Work of this Section. Conform to requirements of Section 13 1101.
  - 2. The Contractor shall perform all excavation of every description and of whatever materials encountered, to the depths indicated on the Drawings or as necessary. The Contractor shall dispose of the excavated materials not required or suitable for backfill as directed, and shall perform such grading as may be necessary to prevent surface water from flowing into the trenches. The Contractor shall provide adequate equipment for the removal of storm or subsurface waters, which may accumulate in the excavated areas.
- B. Trenching:
  - 1. Excavate trenches to lines and grades as indicated on the Drawings and with banks as nearly vertical as practicable.
  - 2. Bottoms of trenches shall be accurately graded to provide uniform bearing on undisturbed soil for the entire length of each section of pipe.
  - 3. The width of the trench at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench wall shall not exceed 8" on either side of the pipe. The width of trench above the top of pipe may be wider if necessary.
  - 4. Over-depth excavations shall be filled with tamped sand to required grades.
  - 5. Excavations of five (5) feet or more in depth shall be shored or supported in conformance with rules, and regulations of State and Federal Governments. Shoring shall be constructed, maintained and removed in a manner to prevent caving of the excavation walls or other load on the pipe.
- C. Backfilling:
  - 1. Material for backfilling of pipes shall be approved granular material less than two (2) inches in diameter obtained from the excavation. No material of a perishable, spongy or otherwise unsuitable nature shall be used as backfill.
  - 2. Backfilling of pipe trenches shall commence immediately after installation and testing to preclude damage to the installed pipe. Backfill around pipe shall be carefully placed so as not to displace or damage the pipe, and shall be carried up symmetrically on each side of the pipe to one foot above the top of the pipe. The material shall be carefully compacted or consolidated before additional backfill is placed.

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3. Backfill above an elevation of one foot above the top of pipe in conformance with requirements of Section 13 11 01. Material for balance of backfill shall be approved granular material less than six (6) inches in diameter taken from the excavation.
4. Unless otherwise indicated on the Drawings, all pipe shall have a minimum of eighteen (18) inches of cover.

### **3.05 GENERAL EQUIPMENT REQUIREMENTS**

- A. Position equipment to result in good appearance and easy access to all components for maintenance and repairs.
- B. Install piping, flues, breeching and ducts so that they do not interfere with equipment access.
- C. Install level, secure and out of moisture. Provide shims, anchors, support straps, angles, grouted bases, or other items as required to accomplish proper installation.
- D. All screws, nuts, bolts and washers shall be galvanized, cadmium plated or stainless steel. After fabrication, hot-dip galvanize unfinished ferrous items for outdoor, below grade or other use subject to moisture.
- E. Extend 1/2" Schedule 40 black steel pipe lubrication tubes from all hard-to-reach locations to front of equipment or to access points. Terminate with proper type of lubrication fitting.

### **3.06 VALVES AND STRAINERS**

- A. If no shut-off is indicated, provide ball valves at inlet connections and balance valves at outlet connections to fixtures and equipment. Provide proper valve trim for service intended.
- B. Use no solder end valves unless noted otherwise; provide adapters in copper tubing systems.
- C. Locate valves with stems above horizontal plane of pipe. In general, locate valves within six (6) feet of floor, out from under equipment, in accessible locations with adequate clearance around hand wheels or levers for easy operation.
- D. Provide all valves, cocks and strainers, full pipe size unless indicated otherwise.
- E. Provide hand wheel operators on all valves 6" and larger, under 6" lever operators may be used.
- F. Provide tool operated valve with stainless steel shaft extension and 'on deck' tool operation for surge chamber butterfly isolation valve.

### **3.07 IDENTIFICATION OF PIPING**

- A. Identify each valve by a numbered brass tag with hole and brass chain mounted on valve stem or handle. Tag to be a minimum of 1" in diameter and numbers at least 1/4" high stamped into tag. Valves and plumbing lines shall be labeled clearly with the source or destination descriptions.
- B. Install an identification chart in a plastic or glass framed enclosure, which schematically illustrates the proper operation of all piping systems and indicates number and location of all valves and control devices within the system.
- C. The direction of flow for the recirculation equipment shall be labeled clearly with directional symbols such as arrows on all piping in the equipment area. Where the recirculation equipment for more than one pool is located on site, the equipment shall be marked as to which pool the equipment serves.

### **3.08 TESTS**

- A. Perform tests in presence of Owner's Representative with no pressure loss or noticeable leaks.
- B. Do not include valves and equipment in tests. Include connection to previously tested sections if systems are tested in sections.
- C. Perform tests as follows:

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System	Test Pressure	Test Medium	Duration
Skimmer Lines and Lawson Main Drain Sump Lines	20psig	Water*	4 hours
Pool Piping	50 psig	Water*	4 hours
Pool Main Drains	30 psig	Water*	4 hours
Domestic Water	150 psig	Water*	4 hours

\*Never test PVC pipe or fittings with air or other gases, always use water.

### 3.09 PIPE MATERIAL APPLICATION

- A. PVC Schedule 40: Below grade swimming pool piping and domestic water piping up to 12" line size; use standard solvent weld fittings.
- B. PVC Schedule 80: Above grade swimming pool piping up to 12" line size; use solvent weld Schedule 80 or epoxy coated cast iron fittings.
- C. Type L Hard Copper: Above grade domestic water piping.
- D. CPVC Schedule 80; Pool Heater Piping.
- E. Schedule 40 Steel: Natural gas piping.

### 3.10 CUTTING AND DRILLING

- A. Cutting or drilling necessary for installation of Work of this Section shall be done only with approval of Owner's Representative.

### 3.11 CLOSING-IN OF UNINSPECTED WORK

- A. Do not cover or enclose Work before testing and inspection. Re-open Work prematurely closed and restore all Work damaged.

### 3.12 QUIETNESS

- A. Quietness is a requirement. Eliminate noise, other than that caused by specified equipment operating at optimum conditions, as directed by Owner's Representative.

### 3.13 FLUSHING OF LINES

- A. Flush or blow out pipes free from foreign substances before installing valves, stops or making final connections. Clean piping systems of dirt and dust prior to initial start-up.
- B. Just prior to plastering the pool, under the observations of the IOR, the pool mechanical system shall be flushed using the pool circulation pump. Circulate water through the mechanical system until the effluent water from the pool return heads runs clean.

### 3.14 CLEAN-UP

- A. After all Work has been tested and approved, the Swimming Pool Subcontractor shall thoroughly clean all parts of the equipment installations, including all pool pipe and fittings in the pool mechanical room. Exposed parts shall be cleaned of cement, plaster and other materials and all grease and oil spots removed with solvent.
- B. The Swimming Pool Subcontractor shall remove debris from the Project site. Cartons, boxes, packing crates and excess materials not used, occasioned by this work shall be disposed of to the satisfaction of the Owner's Representative.
- C. If the above requirements of clean up are not performed to the satisfaction of the Owner's Representative, the Owner reserves the right to order the work done, the cost of which shall be borne by the Swimming Pool Subcontractor.

**END OF SECTION 13 1107**

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## SECTION 13 1108 SWIMMING POOL ELECTRICAL

### PART 1 GENERAL

#### 1.01 WORK INCLUDED

- A. Provide labor, materials and equipment as required to install the swimming pool electrical system including but not limited to:
  - 1. A complete and operable system of service equipment, switchboards, panelboards, conduits, switches, time clocks and wiring for power and lighting, motor control centers.
  - 2. Junction and/or pull boxes, conduits, disconnects, starters, contactors, wiring and connection of all motors and mechanical equipment, including connection and wiring of line voltage controls associated with the mechanical systems.
  - 3. Swimming pool underwater lighting systems.
  - 4. Swimming pool timing system.
  - 5. Complete grounding system as required and shown on the Drawings.
  - 6. Complete equipotential bonding system as required and shown on the Drawings.
  - 7. Adjusting and preliminary operation of the completed electrical system as described in Article 3.6, A of this Section.
  - 8. Cleaning of all completed Work and installation adjustment of all trim and decorative items.

#### 1.02 QUALITY ASSURANCE

- A. Qualifications of Workers:
  - 1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
  - 2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years experience with the materials and methods specified.
  - 3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.
- B. Ordinances and Codes: Materials and construction shall conform with all applicable code requirements, including:
  - 1. National Electrical Code, latest edition; Electrical Safety Orders of the State of California; Department of Industrial Relations; regulations of the State Fire Marshal; rules and regulations of the Board of Underwriters of the Pacific, UL 50, 50E and NEMA 250 rating.
  - 2. Chapter 31 of California Building Code, latest edition.
- C. Verification of Conditions:
  - 1. The locations shown on the Drawings are diagrammatic only and the exact finish location of equipment and materials cannot be indicated. Therefore, locations of all Work and equipment shall be verified to avoid interferences, preserve head room and keep openings and passageways clear. Changes shall be made in locations of equipment and materials which may be necessary to accomplish these purposes.
- D. Preliminary Operations and Testing:
  - 1. Motor driven equipment shall be tested for correct rotation and completion of all connections.

#### 1.03 SUBMITTALS AND SUBSTITUTIONS

- A. Provide submittals in conformance with the requirements of Section 01 3300.
- B. Required submittals include:
  - 1. Conduit and Fittings as specified in Article 2.02 of this Section.

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2. Panelboards as specified in Article 2.06 of this Section.
3. Circuit Breakers as specified in Article 2.07 of this Section.
4. Motor Starters as specified in Article 2.10 and 2.11 of this Section.
5. Fuses as specified in Article 2.13 of this Section.
6. Time Clocks as specified in Article 2.14 of this Section.
7. Ground Fault Circuit Interrupters as specified in Article 2.15 of this Section.
8. 2019 CEC required corrosion resistant enclosures, cabinets and boxes as specified in Article 2.08, 2.11, 2.16 & 2.18 of this Section

C. Submit proof of qualifications as specified in Article 1.02.A of this Section.

#### **1.04 PRODUCT HANDLING**

- A. Delivery: Deliver all materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.
- B. Storage: Store all materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project site.
- C. Protection: Use all means necessary to protect swimming pool electrical materials before, during, and after installation and to protect the installed Work specified in other Sections.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS, GENERAL**

- A. Materials shall be new, in unbroken packages and bear the U.L. label of approval.
- B. Equipment of one type shall be by same manufacturer. One type of equipment for classifications such as:
  1. Switchboards, panels, buss duct, disconnect switches and allied items.
  2. Conduit.
  3. Wire.
  4. Conduit fittings.
  5. Fixtures of the same general type.
  6. Wiring devices.

#### **2.02 CONDUIT AND FITTINGS**

- A. Conduit within or under buildings or where exposed outdoors shall be rigid metal threaded, hot dipped, galvanized, or U.L. approved plastic except where noted otherwise on the Drawings. Metallic conduit shall be of the same metal between outlets or terminals.
- B. Use flexible metallic conduit only for short connections of motors and where specifically called for on Drawings. Maximum length shall be 40". Use only liquid tight flexible metal conduit. Install an unbroken #12 AWG insulated copper grounding conductor in each liquid tight flexible conduit with permanent connection at motor junction box and service panel ground.
- C. Protect, before installation, metallic conduit runs in all slabs laid on grade or in contact with the earth or exposed in damp locations, with two (2) heavy coats of asphaltum rust-resisting compound.
- D. Encase conduits 2-1/2" or larger run underground, outside, or under buildings, in concrete envelopes a minimum of 3" thick, except as indicated otherwise on Drawings or stubouts. Conduits 2 and smaller laid 18" below finish surface in soil.
- E. Low voltage runs underground outside buildings, 1-1/4" or smaller, may be G.I. or sherardized steel conduit, with machine applied wrapping equal to double wrap or Scotch-Wrap #50 tape, half lapped and quadrupled at joints in lieu of concrete encasement.
- F. Service conduits through foundations or concrete members shall run through metal sleeves with adequate clearances for full movement of the conduit. Do not run conduits through footings.

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- G. Secure conduits run exposed on surfaces with one hole heavy-duty straps or fasten with matching fittings to inserts or trapezes, parallel to building walls and ceilings.
- H. Cap all conduit or duct stub-outs with standard factory caps; except cap threaded steel conduit with B.I. water pipe caps in outdoor locations.
- I. Use conduit fittings as manufactured by Crouse-Hinds Company, Appleton Electric Co., or approved equal.
- J. Employ U.L. liquid tight fittings for use with liquid tight flexible metal conduit.
- K. Use unions as manufactured by Appleton, O-Z/Gedney, or approved equal. The use of running threads will not be permitted.
- L. Exposed conduit and fittings in chemical rooms shall be nonmetallic rigid polyvinyl chloride, corrosion resistant rated suitable for installation in corrosive environments and in accordance with the 2019 CEC requirements.

### **2.03 EQUIPOTENTIAL BONDING / GROUNDING**

- A. Bond together and ground to a common ground at a single point all metallic conduit, piping systems, pool reinforcing steel, metal parts of ladders, lifeguard stands, handrails and their supports and the like. The solid copper bonding conductor shall not be smaller than #8 copper.

### **2.04 WIRING CONNECTIONS**

- A. Make connections without strain on conductors, allowing the conductors to take a natural position after connections or taps are made. Include all strand of wire in making the connection.
- B. Make connections for wiring by one of the following means:
  - 1. Make all taps or connections to conductors with compression type connectors except those smaller than #8 B&S gauge may have soldered connections. Solderless connections for #10 AWG or smaller may be used and shall be "Scotchlok", Buchanan, or approved equal. For #8 AWG or larger, they shall be T&B "LockTite", Burndy "Versitaps", or approved equal.
  - 2. All cable or conductor terminal lugs shall be Burndy "Quicklug", IlSCO, or approved equal. Two-piece stamped lugs and solder lugs will not be approved.
  - 3. Paint taped splices in damp or outdoor locations with two (2) coats of insulating paint.
  - 4. Tag all branch circuit wires with circuit number at the panelboard and at each point of use with linen or plastic tags.

### **2.05 CONDUCTORS**

- A. Copper RHW or THW. Do not make splices between boxes.

### **2.06 COLOR CODING**

- A. Neutrals (identified conductors shall be white).
- B. Phase conductors shall be red for phase B; blue for phase C.
- C. Green shall be used for mechanical equipment and receptacle grounds only.

### **2.07 MOTOR WIRING**

- A. Make final connections to motors with the required AWG (Minimum #12), Flamenol machine tool wire, 19 strand. Control wiring for equipment shall be Flamenol machine tool wire, 19 strand of required AWG. Provide corrosion resistant junction boxes at each item of equipment to change from standard building wiring to machine tool wire.
- B. Phase motors as proper in direction of rotation.

### **2.08 PANELBOARDS**

- A. Panelboards shall be flush or surface mounting as indicated with circuit breakers as shown on panel schedule, hinged lockable doors, index card holders and proper bussing.

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- B. Where indicated on the drawings, panelboards shall be furnished with subfeed breakers and/or lugs, split bussing, contractors, time switches, relays, etc., as required.
- C. All panelboards shall be keyed alike.
- D. All panelboard enclosures shall be corrosion resistant rated in accordance with the 2019 CEC requirements.
- E. Furnish corrosion resistant panelboard enclosures and terminal cabinets with Yale 46515 flush locks and LL806 keys except where indicated otherwise herein. Fasten the trim to panel boards and terminal cabinet by means of concealed, bolted or screwed fasteners accessible only when the door is open.
- F. Furnish corrosion resistant panelboard enclosures and terminal cabinets with Yale 46515 flush locks and LL806 keys except where indicated otherwise herein. Fasten the trim to panel boards and terminal cabinet by means of concealed, bolted or screwed fasteners accessible only when the door is open.
- G. Panelboards 208/120 volt, three phase, 4 wire, S/N or 120/240 volt, single phase, 3 wire, S/N.

Panelboard types as manufactured by:

Westinghouse	Type B10B
General Electric	Type NLAB
Square D	Type NQOB

- H. Panelboards for 480/277 volt, three panes, 4 wire, S/N.

Panelboard types as manufactured by:

Westinghouse	Type Pow-R-Line 2
General Electric	Type AE
Square D	Type NEHB
Sylvania	Type NH1B
I.T.E.	Type Approved Equal

- I. Panelboard for bussing sizes thru 400 amp shall be 20" wide surface mounted type. Recess mounted type shall have a 20" wide (maximum) recess metal enclosure with trim plate cover extending 1" on all sides of enclosure. Depth shall be 5-3/4" nominal. Height of panel as required for devices.
- J. Provide 6" additional gutter space in all panels where double lugs are required, or where cable size exceeds bus size. Minimum bottom gutter space shall be 6" high. 12" additional gutter space may be required for aluminum feeders where used.
- K. Panelboards shown on the drawings with relays, time clocks or other control devices shall have a separate metal barriered compartment mounted above panel with separate hinged locking door to match panelboard. Provide mounting sub-base in cabinet for control devices and wiring terminal strips.
  - 1. Panelboard shall have a circuit index card holder removable type, with clear plastic cover. Index card shall have numbers imprinted to match circuit breaker numbers.

## 2.09 CIRCUIT BREAKERS

- A. Breakers shall have a minimum short circuit interrupting rating of 10,000A symmetrical for panelboard voltage thru 240 volt and 14000A for panelboards thru 600 volts or as specified on the drawings. In no case shall the interrupting rating be less than the bus withstand rating unless noted otherwise on the drawings.
- B. Circuit breakers as manufactured by the following companies only are acceptable:
  - 1. General Electric Company
  - 2. Square D Company
  - 3. Westinghouse Company

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#### 4. I.T.E. Company

- C. Circuit breakers shall be arranged in the panels so that the breakers of the proper trip settings and numbers correspond to the numbering in the panel schedules on the drawings. Circuit numbers of breakers shall be black-on-white micarta tabs or other previously approved method. Circuit number tabs which can readily be changed from front of panel will not be accepted. Circuit number tabs shall not be attached to or be a part of the breaker.
- D. Where two or three pole breakers occur in the panels, they shall be common trip units. Single pole breakers with tie-bar between handles will not be accepted.
- E. All circuit breakers shall be padlockable in the "off" position. Locking facilities shall be riveted or mechanically attached to the circuit breaker (submit sample for approval). Other means of attachment shall not be accepted without prior written approval of Architect.
- F. Where branch circuit breakers supply the power to motors and signal systems, the breakers shall be furnished with lockout clips, mounted in the "on" position. The breakers shall be able to trip automatically with lockout clips in place.
- G. Panelboard circuit breakers shall be bolt-on type.

### 2.10 BUSSING

- A. Bussing shall be rectangular cross section copper, or full length silver or tin-plated aluminum.
- B. Bussing shall be braces to withstand symmetrical short circuit ratings as follows or as noted on drawings. In no case shall bus short circuit bracing be less than specified circuit breakers.
- C. Each panelboard shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.

### 2.11 POOL MECHANICAL EQUIPMENT ENCLOSURES, TERMINAL CABINETS & MISC CABINETS

- A. All pool mechanical equipment enclosures, terminal cabinets and miscellaneous cabinets in the pool mechanical room or chemical storage rooms shall be corrosion resistant rated in accordance with the 2019 CEC requirements. Enclosures and all cabinets shall be flush mounted (except where noted a surface) of the size indicated on the drawings, and complete with hinged lockable doors and the number of 2-way screw terminals required for termination of all conductors. Terminal cabinet locks to operated form same key used for panelboards. The trim to terminal cabinets shall be fastened by means of concealed bolted or screwed fasteners accessible behind door to terminal cabinets. Terminal cabinets shall have 5/8" plywood backing.
- B. Provide engraved nameplate on each enclosure and cabinet indicating its designation and system (i.e., Swimming Pool - Panel 'SP').

### 2.12 MOTOR CONTROL INDIVIDUAL STARTERS

- A. Manual Motor Starters:
  - 1. Provide flush or surface mounting manual motor starters with number of poles and size of thermal overload heaters as required for the motor being controlled (equipped with overload heaters, one for each motor lead). Back boxes shall be supplied with all flush mounting starters whether they are toggle type requiring only a 4" square outlet box or the larger type requiring a special box and cover designed to accept the particular unit. All box types shall be corrosion resistant rated in accordance with the 2019 CEC requirements
  - 2. Unless otherwise noted on the drawings, all manual starters for single phase motors, smaller than 1 h.p., shall be the compact toggle type. Manual starters for all single-phase motors, 1 to 5 h.p., and all three phase motors up to 5 h.p. shall be the heavy duty type.
  - 3. Where manual motor starter is shown with pilot light, the pilot light shall be installed in a separate outlet box adjacent to the starter outlet, and engraved nameplate in indicate function of pilot light.
  - 4. The following motor starters as manufactured by:

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Manufacturer	Single Phase 1HP and Below	Others
Arrow Hart	Type RL	Type LL
General Electric	CR 101	Class CR 1062
I.T.E.	Class C10, C11 or C12	Class C20
Square D Company	Class 2510, Type A	Class 2510, Type B & C
Westinghouse	Type MS	Type A100
Allen Bradley	Approved Equal	Approved Equal.

**B. Individual Magnetic Motor Starters:**

1. Magnetic motor starters shall be A.C. line voltage, across-the-line units in corrosion resistant rated enclosure in accordance with the 2019 CEC requirements.
2. All starters located outside of a building whether or not indicated shall be W.P. (weatherproof), and all starters noted W.P. shall be furnished in corrosion resistant rated enclosure in accordance with the 2019 CEC requirements.
3. Starter shall be horsepower rated for the motor controlled, and shall be equipped with properly sized overload elements. Every pole shall be with overload element.
4. Verify the exact motor current and voltage characteristics with the Contractor supplying the motor before installation of a starter.
5. Each starter shall be equipped with "Hand-Off-Auto" switch or stop-start pushbutton as required.
6. Coils shall be designed to operate on voltage indicated on control diagrams and have built-in-under the voltage release for coil circuit to drop motor starter off the line when the line voltage drops below normal operating voltage.
7. The coil control circuit shall be independently fused, sized to protect coil.
8. Starters to be equipped with running pilot light indication with a "Push-to-Test" feature.
9. Magnetic starters shall have a minimum of two auxiliary contacts. Additional auxiliary contacts shall be provided as required to comply with the requirements of the wiring diagrams on the electrical and mechanical drawings and the description of the function in the Mechanical Section of the Specifications.
10. Minimum starter size shall be NEMA size I unless indicated otherwise.
11. The following types of magnetic motor starters as manufactured by:

Manufacturer	Type
General Electric	Class CR 106
I.T.E.	Class A20
Square D Company	Class 8536
Westinghouse	Type A200 (Size 4 Max.) or Class II-200 (Sizes 5-8)

## **2.13 INDIVIDUAL COMBINATION MOTOR STARTERS**

- A. Combination starter shall incorporate fused disconnect switch and individual magnetic motor starter in a common enclosure. Combination starters shall be mounted in corrosion resistant rated enclosure in accordance with the 2019 CEC requirements.
- B. Starters shall comply with NEMA standards, size and horsepower as indicated on drawings General Electric, Square D, Westinghouse or I.T.E.
- C. The disconnect handle used on combination starters shall control the disconnect device with the door opened or closed. The disconnect handle shall be clearly marked as to whether the

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disconnect device is "ON" or "OFF", and shall include a two-color handle grip, the black side visible in the "OFF" position indicating a safe condition, and the red side visible in the "ON" position indicating an unsafe or danger condition.

- D. All starters used in combination starters shall be manufactured in accordance with the latest published NEMA standards, sizes, and horsepower ratings. These starters shall be furnished with three melting alloy type thermal overload relays.
- E. Thermal units shall be of one-piece construction and interchangeable. The starter shall be inoperative if a thermal unit is removed.

#### **2.14 MOTOR CONTROL CENTER, INTERLOCKS AND CONTROL DEVICES**

- A. Refer to mechanical and plumbing drawings and specifications and provide all control devices including timeswitches, relays and interconnection of starters of required.
- B. Mount all relays and timeswitches in a separate compartment in motor control center unless otherwise indicated.
- C. Whether shown on mechanical and plumbing drawings or control center schedules or not, where motors are controlled by external devices (i.e., thermostats, relays, float or pressure switches, etc.) or interlocked with other motors, each motor starter to be equipped with a "Hand-Off-Auto" selector switch in starter cover. Other starters equipped with a "Start/Stop" pushbutton station in starter cover. The Contractor shall be responsible to submit a complete and detailed set of shop drawings, electrical schematic design along with electrical component cut sheets from the MCC panel or the interlock control device manufacturer. RSD Total Control: Allan Pearson 949-380-7878, South Coast Controls: Anthony Ellis 714-998-5656 or approved equal.

#### **2.15 FUSES**

- A. Fuses shall be dual element, current limiting type, U.L. Class RK5 unless otherwise indicated on the drawings. Provide one spare set of fuses of each size and type in each motor control center.

#### **2.16 TIME CLOCKS**

- A. Time clocks shall be provided for all underwater lighting systems and swimming pool circulation pumps not controlled by filter microprocessors.
- B. Contacts shall have a minimum rating of 40 amperes at 277V.
- C. Timing motor shall be heavy duty synchronous, self-starting, high torque type, and shall be rated at 120, 208, 240, 277 volt 60 Hz.
- D. Motor shall operate normally at temperature range of -60 degrees Fahrenheit to +120 degrees Fahrenheit.
- E. Dial shall be 3" diameter, clearly calibrated with day/night zones and 24-hour rotation, with gear to provide one revolution yearly which automatically varies the on/off settings each day according to seasonal changes. Day and month of the year shall show clearly through calendar window on the dial.
- F. Time clocks shall be equipped with 7-spoke omitting wheel marked with days of the week.
- G. Time clocks shall be housed in a corrosion resistant rated enclosure in accordance with the 2019 CEC requirements.
- H. Acceptable manufacturers are Intermatic, Tork, Paragon, or approved equal.

#### **2.17 GROUND FAULT CIRCUIT INTERRUPTERS**

- A. Minimum rating shall be 20 amperes, 125V, 5 milliampere trip setting, Class A per UL943.
- B. Manufacturer to be Crouse-Hinds, Leviton, or approved equal.

#### **2.18 BOXES**

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- A. Boxes shall be of the size required by ordinances or larger, must be corrosion resistant in accordance with the 2019 CEC requirements and of pressed galvanized code gauge steel where concealed or exposed on ceilings. Exposed boxes on walls below 7'6" shall be cast steel similar to "FA" condulets.
- B. Outlets to be surface where wiring is exposed and flush in areas where conduit is concealed.
- C. Provide surface outlets with proper corrosion resistant surface covers. Box and cover shall be deep enough to provide at least 1/4" clearance between back of device and back of box. Where box contains more than one device, use corrosion resistant rated gang box with proper cover in accordance with the 2019 CEC requirements. Surface outlet boxes shall be of the threaded hub type wherever below 8'0".
- D. If necessary for cable installation, additional pull boxes or junction boxes may be installed in accessible locations. Exposed pull boxes and junction boxes shall be corrosion resistant rated in accordance with the 2019 CEC requirements.
- E. Provide exposed junction boxes with proper flat blank galvanized cover. If necessary for cable installation, additional pull boxes or junction boxes may be installed in accessible locations.
- F. Where exposed to weather pull boxes larger than outlet boxes are required, galvanized code gauge sheet steel boxes may be used with covers attached by brass machine screws. Boxes exposed to the weather shall be approved for the purpose, and conduit entrances shall be on the bottom made by means of an interchangeable hub with gasket and adapter nut. Pull boxes not shown on Drawings may be added only after approval of size and location is obtained.
- G. For outlets exposed to weather or where noted, cast outlet boxes shall be Crouse-Hinds, Appleton, or approved equal. Boxes shall have proper number and size hubs. Device plates, covers, adapters and boxes shall be as manufactured by Crouse-Hinds, Appleton, or approved equal.
- H. Exposed junction boxes, outlet boxes and pull boxes for pool chemical rooms shall be nonmetallic suitable for a corrosive environment and in accordance with the 2019 CEC requirements.

## **2.19 IDENTIFICATION MARKINGS**

- A. Plainly mark all motor and electrical appliance control equipment indicating the equipment controlled with engraved metal tags.
- B. Provide laminated plastic nameplates on panelboards on the outside of the door at the top indicating panel designation and feeder source.
- C. Provide laminated plastic nameplates on distribution switchboards and motor control centers at the top center indicating panel designation and feeder source.
- D. Identify each distribution switchboard and motor control center circuit breaker with a laminated plastic nameplate indicating its' use.
- E. Type panelboard directories on the forms provided with the equipment, indicating the use of each branch circuit breaker.
- F. Fasten all laminated plastic nameplates to surfaces with two (2) or more screws.

## **EXECUTION**

### **3.01 INSPECTION**

- A. Verify conditions at the Project site before submitting bid. Be responsible for providing all necessary wiring for the new electrical systems. Wherever wiring is being disrupted due to remodeling or changes, reconnect existing and provide new wiring circuits to accomplish a fully operable system at no additional cost to the Owner.

### **3.02 COORDINATION**

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- A. The Drawings are essentially diagrammatic and indicate the desired location, size, routes, connection points, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the Work so as to provide the best possible installation in the available space and to overcome difficulties, limitations or interference wherever encountered. Be responsible for the correct placement of this Work, the proper location and connection in relation to Work of other trades, for determining the exact location of all conduits, outlets and equipment, and for installing the conduits in such a manner as to conform to the structure, avoid obstruction, preserve headroom and keep openings and passageways clear. Particular attention is directed to the close coordination required on exposed Work. Locations shown on Architectural or Mechanical Drawings if different than those shown on Electrical Drawings should be communicated to the Owner's Representative in writing for clarification.

### 3.03 INSTALLATION

- A. Trenching and Backfill: Conform with requirements of Section 13 1101. Provide minimum cover as required by Code.
- B. Conduit Installation:
1. Conduit and metallic raceway systems shall be mechanically and electrically continuous from sources of current to all outlets in a manner to provide a continuous grounding path. Close ends of conduit during construction to prevent entrance of dirt or moisture.
  2. Securely fasten conduit to the building construction within three feet of each outlet and within every ten feet thereafter. Secure it to boxes, cabinets, pull boxes, terminals with two locknuts and ends equipped with bushings or a terminal fitting. Cut square with ends carefully reamed.
  3. Make bends or elbows so that the conduit will not be injured or flattened.
  4. Use insulated metallic bushings in all places where bushings are required.
  5. Run exposed conduits level or plumb and parallel to the construction members of the building. No cutting across or diagonal runs will be permitted. Neatly surmount structural obstructions encountered on conduit runs by the use of fittings or pull boxes.
  6. Identify feeder conduits by stamped metal tags secured to exposed section of conduit in main or sub-panels.
  7. Make up all threaded conduit joints gas and watertight with conductive sealer except conduit above ground in dry indoor locations.
  8. Rigidly support all boxes independently of the conduit system.
- C. Connections to Equipment:
1. Fully connect, in an approved manner, all electrical outlets, apparatus, motors, equipment, fixtures, wiring devices and appliances whether they are installed under the Electrical Contract or not, which require electrical connections, to the corresponding electrical system outlet.
  2. Where the Work of this Section requires connections to be made to equipment that is furnished and set-in-place under other Sections, obtain such roughing-in dimensions from the manufacturer or supplier of each item as required and assume full responsibility for the installation of the connections thereto.

### 3.04 ADJUSTMENT AND CLEAN-UP

- A. Preliminary Operation: Should the Owner's Representative deem it necessary to operate the electrical installation or any part thereof prior to Substantial Completion of the Work, consent to such preliminary operation and supervise conduction of same. Subcontractor shall pay all costs occasioned by such operation. Preliminary operation shall not be construed as an acceptance of any Work installed under this Contract.
- B. Clean-up: Upon completion of the Work of this Section, immediately remove all swimming pool electrical materials, debris and rubbish occasioned by this Work to the approval of the Owner's Representative.

**END OF SECTION 13 1108**

**SECTION 21 0500**  
**COMMON WORK RESULTS FOR FIRE SUPPRESSION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Above ground piping.
- B. Escutcheons.
- C. Pipe, fittings, sleeves, escutcheons, hangers, seals, and connections for sprinkler systems.
- D. Expansions - hose and braid.
- E. Mechanical couplings.
- F. Pipe hangers and supports.

**1.02 RELATED REQUIREMENTS**

- A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.
- B. Section 21 0523 - General-Duty Valves for Water-Based Fire-Suppression Piping.
- C. Section 21 0553 - Identification for Fire Suppression Piping and Equipment: Piping identification.
- D. Section 21 1300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.
- E. Division 22 - Plumbing
- F. Division 23 - HVAC
- G. Division 26 - Electrical
- H. Division 28 - Electronic Safety and Security

**1.03 REFERENCE STANDARDS**

- A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2010.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2011.
- C. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2011.
- D. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2013.
- E. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings; 2012.
- F. ASME B16.11 - Forged Fittings, Socket-welding and Threaded; 2011.
- G. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- H. ASME B16.25 - Buttwelding Ends; 2012.
- I. ASME B36.10M - Welded and Seamless Wrought Steel Pipe; 2004.
- J. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2014).
- K. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- L. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2009 (Reapproved 2014).
- M. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2015.
- N. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015.

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- O. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2013.
- P. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2012.
- Q. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2012.
- R. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2009.
- S. AWWA C606 - Grooved and Shouldered Joints; 2011.
- T. ITS (DIR) - Directory of Listed Products; current edition.
- U. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.
- V. NFPA 24 - Standard for the Installation of Private Fire Service Mains and their Appurtenances; 2016
- W. NFPA 25 - Standard for the Testing, Inspection, and Maintenance of Water Based Fire Suppression Systems; 2017
- X. NFPA 72 - National Fire Alarm and Signaling Code; 2016
- Y. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- Z. California Building Code; 2019
- AA. California Fire Code; 2019

#### **1.04 SUBMITTALS**

- A. Contractor to include items listed in product section along with any additional items required to provide a complete and fully functioning installation per NFPA 13 and all adopted building and fire codes.
- B. Product Data: Provide manufacturer's catalog information. Where more than one product or model is available, provide red marking arrows or highlights on the cut sheets to clearly identify the product models, finishes, orientations, and any further clarification needed of the intended products for use, to complete a thorough review.
- C. Shop Drawings: Indicate materials and finishes used, joint methods, pipe supports, floor and wall penetration details, and sealing methods. Indicate installation layout, hanger layout, weights, mounting and support details, seismic restraints with calculations, and piping connections.
- D. Review of submittals does not relieve Contractor from coordinating installation of work with other trades, or from compliance with Codes and Standards.
- E. Project Record Documents: Record actual locations of components and tag numbering.
- F. Operation and Maintenance Data: Include installation instructions and spare parts lists.
- G. Provide Owner with the following:
  - 1. Manufacturer's literature and instructions describing operation and maintenance of equipment and devices installed.
  - 2. Typewritten chart with identification and location of all access panels serving equipment and valves. Incorporate into Operation & Maintenance (O&M) manual.
  - 3. Typewritten valve schedule indicating valve number, fixture/equipment or areas served by each numbered valve. Incorporate into O&M manual.
  - 4. 8-1/2 x 11 laminated flow diagram showing isolation valve locations, drain valve locations, and system boundaries, where applicable, and attach it to the system riser.
  - 5. Current copy of NFPA 25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
- H.

#### **1.05 QUALITY ASSURANCE**

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

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- B. Fabrication shop must provide welding certifications and copy of weld stamp when requested. Weld stamp to be provided on all pipe at welds.
- C. Contractor Qualifications: Provide licensed persons employed by sprinkler contractor to perform planning, calculations, layout, installation, and testing of fire protection systems. The following are acceptable:
  - 1. Licensed Professional Engineer
  - 2. National Institute for Certification of Engineering Technologies (NICET) Level III
  - 3. Certified sprinkler designer
- D. Installer Qualifications: Company specializing in performing the work of this section shall provide journeyman sprinkler fitter(s) for installation and supervision with minimum 5 years experience.
- E. Contractor shall be licensed in the State of California for installation of fire protection systems.
- F. Comply with UL (DIR) requirements.
- G. Valves: Bear UL (DIR) product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- H. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.
- I. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to the site under provisions of Division 01
- B. Store and protect products under provisions of Division 01
- C. All materials shall be stored in a clean, dry space.
- D. Promptly inspect shipments to ensure material is undamaged and complies with Specifications. Storage and protection methods must allow inspection to verify products.
- E. Deliver and store valves in shipping containers, with labeling in place.
- F. Provide temporary protective coating on cast iron and steel valves.
- G. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- H. Furnish pipe with plastic end-caps/plugs on each end of pipe. Maintain end-caps/plugs through shipping, storage and handling, and installation to prevent pipe-end damage and to eliminate dirt and construction debris from accumulating inside of pipe. Protect fittings and unions by storage inside or by durable, waterproof, aboveground packaging.
- I. Cover pipe and fitting to prevent rust, corrosion, or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade.
- J. Offsite storage agreements will not relieve Contractor from using proper storage techniques.

### **PART 2 PRODUCTS**

#### **2.01 GENERAL REQUIREMENTS**

- A. Sprinkler Systems: Conform work to NFPA 13.
  - 1. Follow DSA requirements
- B. Comply with all building and fire code adoptions for the project location.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX.
- D. Provide system pipes, fittings, sleeves, escutcheons, seals, and other related accessories.

## 2.02 BURIED PIPING:

### PIPING TO 5'-0" OUTSIDE BUILDING FACE

- A. Ames ES.A - Series IBR - In Building Riser
- B. Steel Pipe: ASTM A 53/A 53M Schedule 40 or ASTM A 795 Standard Weight, galvanized, with AWWA C105 polyethylene jacket, or double layer, half-lapped polyethylene tape.
- C. Ductile Iron Pipe: AWWA C151/A21.51. Ductile iron, Class 52, American Water Works Association (AWWA) C151, minimum 350 psi working pressure, with standard cement mortar lining, AWWA C104, American National Standards Institute (ANSI) A21.4
  - 1. Fittings: AWWA C110/A21.10, Ductile iron or grey iron, mechanical joint, 350 psi working pressure, AWWA C153, cement mortar lined, AWWA C104.
  - 2. Encasement: Polyethylene encasement, 0.2 mm(8 mil) thick, AWWA C105
  - 3. Joints: AWWA C111/A21.11, styrene-butadiene rubber (SBR) or vulcanized SBR gasket.
  - 4. Mechanical Couplings: Shaped composition sealing gasket, steel bolts, nuts, and washers.

## 2.03 ABOVE GROUND PIPING

- A. Carbon Steel Pipe 2" and smaller: ASTM A53 Schedule 40 or ASTM A795 Schedule 40, galvanized.
  - 1. Fittings: ASME B16.9, wrought steel, buttwelded, ASTM A234/A234M, wrought carbon steel or alloy steel, or ASME B16.5, steel flanges and fittings.
    - a. Cast Iron Flanged Fittings: ASME B16.1, flanges and flanged fittings.
    - b. Cast Iron Threaded Fittings: Class 125, ANSI B16.4, 175 psi CWP rating.
    - c. Malleable Iron Threaded Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M class 150, 300 psi CWP rating, ASME B16.3
    - d. Ductile Iron Threaded Fittings: ASME B16.3, ASTM A536 Grade 65-45-12, thread per ASME B1.20.1; shall be UL listed for fire protection use.
      - 1) Ductile iron threaded fittings have higher tensile strength than that of steel pipe. Therefore, over tightening can cause damage to pipe threads which may cause leakage and/or facilitate aggressive internal pipe corrosion. Ductile iron fittings should be tightened approximately three turns beyond hand tight, but no more than four turns, per manufacturer. Any deficiencies or damage caused to owners system or property due to over-tightening, shall be the full liability and responsibility of the contractor to pay for and correct.
    - e. Carbon steel butt weld, ASTM A234 Grade WPB/American Society of Mechanical Engineers (ASME) B16.9, standard weight, seamless.
    - f. Ductile iron or malleable iron, roll grooved for mechanical coupling: ASTM A47, 175 psi CWP rating, malleable iron.
      - 1) Fitting, gasket, and coupling shall be furnished by same manufacturer.
    - g. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
    - h. Mechanical formed fittings: ASME 16.9, including, but not limited to, tees, saddle fittings, bushings and mechanical sprinkler head fittings shall not be used.
  - 2. Joints:
    - a. Threaded, tapered pipe threads, ANSI B1.20.1
    - b. Flanged, cast iron, 175 psi CWP rating, ANSI B16.1, square head machine bolts with semi-finished hexagon nuts, ASTM A183, neoprene gasket
    - c. Welded, welding electrodes shall be Lincoln or equal with coating and diameter as recommended by manufacturer for type and thickness of work being done.
    - d. Mechanical:
      - 1) Flexible mechanical, malleable iron, ASTM A47, equal to Victaulic Style 75
      - 2) Rigid mechanical, ductile iron, ASTM A-536, equal to Victaulic Style 009N
      - 3) Wet systems gasket: Grade E EPDM gasket per UL 157 and UL 213

- 4) Rigid or zero flex type couplings shall be provided when operating pressures cause piping to move out of place or sway on hangers. Flexible couplings may be used where pipe is braced or clamped into rigid position.
- B. Carbon Steel Pipe 2-1/2" and larger: Schedule 10 pipe ASTM A795, ASTM A135, galvanized.
  1. Fittings:
    - a. Carbon steel butt weld, ASTM A234 Grade WPB/ASME B16.9, Schedule 10, seamless
    - b. Ductile iron or malleable iron, roll grooved for mechanical coupling, 175 psi CWP rating, malleable iron conforming to ASTM A47.
      - 1) Fitting, gasket, and coupling shall be furnished by same manufacturer.
  2. Joints:
    - a. Welded, welding electrodes shall be Lincoln or equal with coating and diameter as recommended by manufacturer for type and thickness of work being done.
    - b. Mechanical:
      - 1) Flexible mechanical, malleable iron, ASTM A47, equal to Victaulic Style 75
      - 2) Rigid mechanical, ductile iron, ASTM A-536, equal to Victaulic Style 009N
      - 3) Wet systems gasket: Grade E EPDM gasket per UL 157 and UL 213
      - 4) Rigid or zero flex type couplings shall be provided when operating pressures cause piping to move out of place or sway on hangers. Flexible couplings may be used where pipe is braced or clamped into rigid position.
- C. Plain end couplings (Roust-A-Bouts, Plainloks or similar couplings) are not allowed on either new or existing sprinkler systems.
- D. Adjustable drop nipples are not allowed on either new or existing sprinkler systems.
- E. All fittings for galvanized pipe shall match the pipe finish and be galvanized.
- F. Clamp-on or saddle type fittings (i.e. mechanical tees or tee lox) are not allowed on new pipe. Outlet fittings inserted into holes drilled into piping are not allowed.

#### **2.04 ESCUTCHEONS**

- A. Material:
  1. Fabricate from nonferrous metal.
  2. Chrome-plated.
- B. Construction:
  1. Mounting on pipe use split-pattern or split ring type.

#### **2.05 PIPE HANGERS AND SUPPORTS**

- A. Provide hangers and associated parts to support piping in perfect alignment without sagging or interference, to permit free expansion and contraction, and meet requirements of NFPA 13 and manufacturer's installation instructions.
  1. All hanger materials shall be listed for fire protection use.
- B. Select and size building attachments per Manufacturer Standardization Society (MSS) standards and manufacturer's published load rating.
- C. Coordinate hanger support installation to group piping of all trades.
- D. Hang pipe from building members using either concrete inserts for concrete construction or beam clamps for steel construction. Installation shall comply with manufacturer's installation instructions. Expansion type inserts may be used for branch piping.
- E. Suspend hangers by means of electroplated zinc or hot-dipped galvanized finish hanger rods, attachments, and supports.
- F. Support pipe from top flange of beams.
- G. Do not support equipment or piping from metal roof deck that does not have a concrete poured top.

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- H. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm): Carbon steel, adjustable swivel, split ring.
  - 1. Manufacturers:
    - a. Eaton; [www.eaton.com](http://www.eaton.com); Tolco Fire Protection Solutions.
    - b. Anvil International; [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
- I. Hangers for Pipe Sizes 2 inches (50 mm) and Over: Carbon steel, adjustable, swivel ring.
  - 1. Manufacturers:
    - a. Anvil International; [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
    - b. Eaton; [www.eaton.com](http://www.eaton.com); Tolco Fire Protection Solutions
- J. Vertical Support: Steel riser clamp.
  - 1. Manufacturers:
    - a. Anvil International; Model 261: [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
    - b. Eaton; [www.eaton.com](http://www.eaton.com); Tolco Fire Protection Solutions.
- K. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support. Pipe stands shall be provided with a galvanized finish and be anchored into the floor.
  - 1. Manufacturers:
    - a. Anvil International: [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
    - b. Eaton; [www.eaton.com](http://www.eaton.com); Tolco Fire Protection Solutions.
- L. Seismic Hangers:
  - 1. Restraining clips/clamps are required in locations where vibration may be a concern.
  - 2. Install flexible fitting at building's expansion or seismic joints per manufacturer's instructions.
  - 3. All seismic hangers shall be listed for fire protection use.
  - 4. All seismic hanger attachments shall be zinc coated or have a galvanized finish.
  - 5. Manufacturers:
    - a. Anvil International Seismic Bracing Products.
    - b. Eaton: Tolco Fire Protection Solutions.

## **2.06 MECHANICAL COUPLINGS**

- A. Manufacturers:
  - 1. Victaulic Company; FireLock Style 009H: [www.victaulic.com/#sle](http://www.victaulic.com/#sle).
- B. Rigid Mechanical Couplings for Grooved Joints:
  - 1. Dimensions and Testing: Comply with AWWA C606.
  - 2. Minimum Working Pressure: 300 psig (2065 kPa).
  - 3. Housing Material: Fabricate of ductile iron complying with ASTM A536.
  - 4. Housing Coating: Factory applied orange enamel or galvanized finished.
  - 5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F (minus 34 degrees C) to 230 degrees F (110 degrees C).
  - 6. Bolts and Nuts: Hot-dipped-galvanized or zinc-electroplated steel.
  - 7. Couplings provided shall be from the same manufacturer of the fitting manufacturer.

## **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.
- C. Prepare piping connections to equipment with flanges or unions.

### **3.02 INSTALLATION**

- A. Install hydraulically designed sprinkler system and associated accessories according to NFPA 13 and as shown on the contract drawings.

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- B. Install pipe, fittings, couplings, and valves according to requirements of manufacturer.
- C. Pipe and fittings shall be of corresponding materials when assembled.
- D. Where galvanized pipe is used, hangers and fittings shall match the pipe type and also be galvanized or zinc coated.
- E. Group piping whenever practical at common elevations, considering space needed by other trades.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Pipe Hangers and Supports:
  - 1. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
  - 2. Place hangers within 12 inches (300 mm) of each horizontal elbow.
  - 3. Use hangers with 1-1/2 inch (40 mm) 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.
- H. Provide auxiliary drains at low points of systems per requirements of NFPA 13.
- I. Do not penetrate building structural members unless indicated.
- J. Provide sleeves when penetrating footings, floors, and walls. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
  - 1. Non bearing wall partitions shall not require sleeves or to be provided with clearances.
  - 2. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
    - a. Fill hole clearance with pea gravel or insulation and caulk.
- K. 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 split chrome plated escutcheons in occupied spaces to conceal openings for wall and ceiling penetrations.
- L. Die-cut threaded joints with full-cut, standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
- M. Use joint compound sparingly
- N. Provide reducing fittings or provide shop fabricated weld-o-lets to change pipe sizes in sprinkler/standpipe systems. No bushings or grooved reducing couplings, such as Victaulic Style 750, are allowed.
- O. Coat threads exposed to outside elements with rust inhibiting paint equal to Rusto-leum.
  - 1. Pipe dope and tape are not approved equivalents
  - 2. Provide black paint with black pipe and silver paint with galvanized pipe.
  - 3. Wipe threads clean with a cloth and use spray can application to coat thread only.
    - a. Overspray on pipe and/or fitting is not of concern.

### 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

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## **SECTION 21 0523**

### **GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Bronze butterfly valves with indicators.
- B. Iron butterfly valves with indicators.
- C. Check valves.
- D. Bronze OS&Y gate valves.
- E. Iron OS&Y gate valves.
- F. NRS gate valves.
- G. Indicator posts.
- H. Trim and drain valves.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 21 0500 - Common Work Results for Fire Suppression: Pipe and fittings.
- B. Section 21 0553 - Identification for Fire Suppression Piping and Equipment.
- C. Section 21 1300 - Fire-Suppression Sprinkler Systems.
- D. Division 22 - Plumbing
- E. Division 23 - HVAC
- F. Division 26 - Electrical
- G. Division 28 - Electronic Safety and Security

##### **1.03 REFERENCE STANDARDS**

- A. ASME B1.20.1 - Pipe Threads, General Purpose (Inch); 2013.
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2010.
- C. FM (AG) - FM Approval Guide; current edition.
- D. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.
- E. NFPA 24 - Standard for the Installation of Private Fire Service Mains and their Appurtenances; 2016
- F. NFPA 72 - National Fire Alarm and Signaling Code; 2016
- G. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- H. UL 262 - Gate Valves for Fire-Protection Service; Current Edition, Including All Revisions.
- I. UL 789 - Indicator Posts for Fire-Protection Service; Current Edition, Including All Revisions.
- J. California Building Code; 2019
- K. California Fire Code; 2019

##### **1.04 SUBMITTALS**

- A. Contractor to include items listed in product section along with any additional items required to provide a complete and fully functioning installation per NFPA 13 and all adopted building and fire codes.
- B. Product Data: Provide manufacturer's catalog information. Where more than one product or model is available, provide red marking arrows or highlights on the cut sheets to clearly identify the product models, finishes, orientations, and any further clarification needed of the intended products for use, to complete a thorough review.

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- C. Review of submittals does not relieve Contractor from coordinating installation of work with other trades, or from compliance with Codes and Standards.
- D. Project Record Documents: Record actual locations of components and tag numbering.
- E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
- F. Provide Owner with the following:
  - 1. Manufacturer's literature and instructions describing operation and maintenance of equipment and devices installed.
  - 2. Typewritten chart with identification and location of all access panels serving equipment and valves. Incorporate into Operation & Maintenance (O&M) manual.
  - 3. Typewritten valve schedule indicating valve number, fixture/equipment or areas served by each numbered valve. Incorporate into O&M manual.
  - 4. 8-1/2 x 11 laminated flow diagram showing isolation valve locations, drain valve locations, and system boundaries, where applicable, and attach it to the system riser.
  - 5. Current copy of NFPA 25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

#### **1.05 QUALITY ASSURANCE**

- A. Comply with UL (DIR) requirements.
- B. Valves: Bear UL (DIR) product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- C. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.
- D. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to the site under provisions of Division 01
- B. Store and protect products under provisions of Division 01
- C. All materials shall be stored in a clean, dry space.
- D. Promptly inspect shipments to insure material is undamaged and complies with Specifications. Storage and protection methods must allow inspection to verify products.
- E. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, grooves and flanged faces.
  - 3. Set valves open to minimize exposure of functional surfaces.
- F. Deliver and store valves in shipping containers, with labeling in place.
- G. 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 and maintain at higher than ambient dew point temperature.
    - b. If outdoor storage is unavoidable, store valves off the ground in watertight enclosures.
- H. Use the following precautions for handling:
  - 1. Use sling to handle large valves, rigged to avoid damage to exposed parts.
  - 2. Do not use operating handles or stems as lifting or rigging points.
- I. Offsite storage agreements will not relieve Contractor from using proper storage techniques.

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## **PART 2 PRODUCTS**

### **2.01 GENERAL REQUIREMENTS**

- A. Comply with NFPA 13 for valves.
- B. Valve Pressure Ratings: Not less than 175 psi pressure rated, or higher as required.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.

### **2.02 BRONZE BALL VALVES WITH INDICATORS**

- A. Manufacturers:
  - 1. Nibco; 505-W-8: [www.nibco.com](http://www.nibco.com).
  - 2. Victaulic; Series 728: [www.victaulic.com](http://www.victaulic.com).
  - 3. Watts; Series LFAFBV-FP: [www.watts.com](http://www.watts.com)
- B. Minimum Pressure Rating: 175 psig (1200 kPa).
- C. Body Material: Bronze.
- D. Seat: Chrome plated brass.
- E. Stem: Bronze or stainless steel.
- F. Actuator: Brass travel nut.
- G. Supervisory Switch: Internal or external.

### **2.03 IRON BUTTERFLY VALVES WITH INDICATORS**

- A. Manufacturers:
  - 1. Nibco; GD-1765-4N/8N: [www.nibco.com](http://www.nibco.com).
  - 2. Kennedy; G300/G300C: [www.kennedy.com](http://www.kennedy.com).
  - 3. Victaulic; Series 705: [www.victaulic.com](http://www.victaulic.com)
- B. Minimum Pressure Rating: 175 psig (1200 kPa).
- 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.

### **2.04 CHECK VALVES**

- A. Manufacturers:
  - 1. Kennedy; [www.kennedyvalve.com](http://www.kennedyvalve.com).
  - 2. Nibco; [www.nibco.com](http://www.nibco.com)
  - 3. Victaulic; [www.victaulic.com](http://www.victaulic.com)
- B. Minimum Pressure Rating: 175 psig (1200 kPa).
- 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.

### **2.05 BRONZE OS&Y GATE VALVES**

- A. Manufacturers:
  - 1. Nibco; [www.nibco.com](http://www.nibco.com).

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- 2. Kennedy; [www.kennedy.com](http://www.kennedy.com).
- 3. Victaulic; [www.victaulic.com](http://www.victaulic.com)
- B. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
- C. Minimum Pressure Rating: 175 psig (1200 kPa).
- D. Body and Bonnet Material: Bronze or brass.
- E. Wedge: One-piece bronze or brass.
- F. Wedge Seat: Bronze.
- G. Stem: Bronze or brass.
- H. Packing: Non-asbestos PTFE.
- I. Supervisory Switch: External.
- J. End Connections: Threaded, grooved, or flanged.

## **2.06 IRON OS&Y GATE VALVES**

- A. Manufacturers:
  - 1. Kennedy Valve: [www.kennedyvalve.com/#sle](http://www.kennedyvalve.com/#sle).
  - 2. Nibco; [www.nibco.com](http://www.nibco.com).
  - 3. Victaulic; [www.victaulic.com](http://www.victaulic.com)
- B. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
- C. Minimum Pressure Rating: 175 psig (1200 kPa).
- D. Body and Bonnet Material: Cast or ductile iron.
- E. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
- F. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
- G. Stem: Brass or bronze.
- H. Packing: Non-asbestos PTFE.
- I. Supervisory Switch: External.
- J. End Connections: Flanged.

## **2.07 NRS GATE VALVES**

- A. Manufacturers:
  - 1. Kennedy Valve: [www.kennedyvalve.com/#sle](http://www.kennedyvalve.com/#sle).
  - 2. Nibco; [www.nibco.com](http://www.nibco.com).
  - 3. Victaulic; [www.victaulic.com](http://www.victaulic.com)
- B. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
- C. Minimum Pressure Rating: 175 psig (1200 kPa).
- D. Body and Bonnet Material: Cast or ductile iron.
- E. Wedge: Cast or ductile iron with elastomeric coating.
- F. Stem: Brass or bronze.
- G. Packing: Non-asbestos PTFE.
- H. Supervisory Switch: External.
- I. End Connections: Flanged.

## **2.08 INDICATOR POSTS**

- A. Manufacturers:

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1. Kennedy Valve: [www.kennedyvalve.com/#sle](http://www.kennedyvalve.com/#sle).
  2. Nibco; [www.nibco.com](http://www.nibco.com).
  3. Victaulic; [www.victaulic.com](http://www.victaulic.com).
- B. UL 789 and FM (AG) standard listing for indicator posts.
- C. Type: Underground.
- D. Base Barrel Material: Cast or ductile iron.
- E. Cap: Cast or ductile iron.

## 2.09 TRIM AND DRAIN VALVES

- A. Ball Valves:
1. Manufacturers:
    - a. Nibco; [www.nibco.com](http://www.nibco.com).
    - b. Victaulic; [www.victaulic.com](http://www.victaulic.com).
    - c. Milwaukee; [www.milwaukeevalve.com](http://www.milwaukeevalve.com).
  2. Description:
    - a. Pressure Rating: 175 psig (1200 kPa).
    - 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. Manufacturers:
    - a. United Brass Works, Inc.; [www.ubw.com](http://www.ubw.com).
    - b. Nibco; [www.nibco.com](http://www.nibco.com).
    - c. Milwaukee; [www.milwaukeevalve.com](http://www.milwaukeevalve.com).
  2. Description:
    - a. Pressure Rating: 175 psig (1200 kPa).
    - 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. Manufacturers:
    - a. United Brass Works, Inc.; [www.ubw.com](http://www.ubw.com).
    - b. Nibco; [www.nibco.com](http://www.nibco.com).
    - c. Milwaukee; [www.milwaukeevalve.com](http://www.milwaukeevalve.com).
  2. Description:
    - a. Pressure Rating: 175 psig (1200 kPa).
    - 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.
- D. Test and Drain Valves:

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1. Manufacturers:
    - a. AGF; [www.testandrain.com](http://www.testandrain.com)
    - b. Globe; [www.globesprinkler.com](http://www.globesprinkler.com)
    - c. Victaulic; [www.victaulic.com](http://www.victaulic.com)
  2. Description:
    - a. Pressure Rated: 300 psig
    - b. Body Material: Brass or bronze
    - c. Ends: Threaded
    - d. Attachments: With pressure relief valve set to operate at 175 psi or 10 psi above system working pressure, whichever is greater.
    - e. Orifice: smallest size of sprinkler K-factor
- E. Air Release Valves:
1. Manufacturers:
    - a. Engineered Corrosion Solutions
    - b. Potter Electric
    - c. AGF Manufacturing
  2. Description:
    - a. Automatic float type air vent
    - b. UL listed, FM approved "Automatic Air release Valve for Sprinkler Systems"
    - c. Rated to 175 psi water working pressure
  3. Valve shall be installed in an accessible location to permit operation, maintenance, and visual inspection of the status of the valve.

### **PART 3 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. Install permanent identification signs indicating portion of system controlled by each valve.
- B. Install check valve in water supply connections and backflow preventer at potable water supply connections.
- 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 0553 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**

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## **SECTION 21 0553**

### **IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Pipe markers.

##### **1.02 RELATED REQUIREMENTS**

- A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.
- B. Section 09 9123 - Interior Painting: Stencil paint.

##### **1.03 REFERENCE STANDARDS**

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2007.

##### **1.04 SUBMITTALS**

- A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Product Data: Provide manufacturers catalog literature for each product required.
- C. Manufacturer's Installation Instructions: Indicate special procedures, and installation instructions.
- D. Project Record Documents: Record actual locations of tagged valves.

#### **PART 2 PRODUCTS**

##### **2.01 IDENTIFICATION APPLICATIONS**

- A. Control Panels: Nameplates.
- B. Piping: Pipe markers.
- C. Valves: Nameplates.

##### **2.02 MANUFACTURERS**

- A. Brady Corporation: [www.bradyid.com](http://www.bradyid.com).
- B. Champion America, Inc: [www.Champion-America.com](http://www.Champion-America.com).
- C. Seton Identification Products: [www.seton.com/aec](http://www.seton.com/aec).

##### **2.03 NAMEPLATES**

- A. Manufacturers:
  - 1. Brimar Industries, Inc: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  - 2. Kolbi Pipe Marker Company: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  - 3. Seton Identification Products, a Tricor Direct Company: [www.seton.com/#sle](http://www.seton.com/#sle).
- B. Description: Laminated three-layer plastic with engraved letters.
  - 1. Letter Color: White.
  - 2. Letter Height: Equipment, control panels 1 inch (25 mm).
  - 3. Letter Height: Controls and small components, 1/4 inch (6 mm).
  - 4. Background Color: Red.

##### **2.04 TAGS**

- A. Manufacturers:
  - 1. Advanced Graphic Engraving, LLC: [www.advancedgraphicengraving.com/#sle](http://www.advancedgraphicengraving.com/#sle).
  - 2. Brady Corporation: [www.bradycorp.com/#sle](http://www.bradycorp.com/#sle).
  - 3. Brimar Industries, Inc: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  - 4. Craftmark Pipe Markers: [www.craftmarkid.com/#sle](http://www.craftmarkid.com/#sle).

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5. Kolbi Pipe Marker Company: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  6. Seton Identification Products, a Tricor Direct Company: [www.seton.com/#sle](http://www.seton.com/#sle).
- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

## **2.05 PIPE MARKERS**

- A. Manufacturers:
1. Brady Corporation: [www.bradycorp.com/#sle](http://www.bradycorp.com/#sle).
  2. Brimar Industries, Inc: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  3. Craftmark Pipe Markers: [www.craftmarkid.com/#sle](http://www.craftmarkid.com/#sle).
  4. Kolbi Pipe Marker Company: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  5. Seton Identification Products, a Tricor Company: [www.seton.com/#sle](http://www.seton.com/#sle).
- 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. Secure to pipe using two (2) bands of adhesive tape with flow arrows supplied by the manufacturer. Install securing bands completely around pipe and overlapped.
- E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.

## **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.
- E. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.
- F. Identify valves in main and branch piping with tags.
- G. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers. Use tags on piping 3/4 inch (20 mm) diameter and smaller. Identify service and flow direction. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) 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**

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## SECTION 21 1300 FIRE-SUPPRESSION SPRINKLER SYSTEMS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.

#### 1.02 RELATED REQUIREMENTS

- A. The Drawings and General Provisions of the Contract, including the General Conditions, Special Conditions and Division 1 General Requirements apply to this section.
- B. Section 21 0500 - Common Work Results for Fire Suppression: Pipe and fittings.
- C. Section 21 0523 - General-Duty Valves for Water-Based Fire-Suppression Piping.
- D. Section 21 0553 - Identification for Fire Suppression Piping and Equipment.
- E. Division 22 - Plumbing
- F. Division 23 - HVAC
- G. Division 26 - Electrical
- H. Division 28 - Electronic Safety and Security

#### 1.03 REFERENCE STANDARDS

- A. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.
- B. UL (DIR) - Online Certifications Directory; current listings at [database.ul.com](http://database.ul.com).

#### 1.04 SUBMITTALS

- A. Contractor to include items listed in product section along with any additional items required to provide a complete and fully functioning installation per NFPA 13 and all adopted building and fire codes.
- B. Product Data: Provide manufacturer's catalog information. Where more than one product or model is available, provide red marking arrows or highlights on the cut sheets to clearly identify the product models, finishes, orientations, and any further clarification needed of the intended products for use, to complete a thorough review. Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections, and accessories.
- C. Shop Drawings: Fire sprinkler system design is not a deferred submittal.
  - 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, seismic details and calculations, components and accessories. Indicate system controls.
  - 3. Submit shop drawings to LP Engineers for approval.
  - 4. Installation is to conform to approved fire sprinkler plans.
  - 5. Approved documents do not relieve the contractor of field coordination. It is the fire sprinkler contractors' responsibility to coordinate piping locations with the work of other trades.
  - 6. Preparation of installation and fabrication drawings is the responsibility of the fire sprinkler contractor.
- D. Material Data: Approved material data is a guideline. The fire sprinkler system design parameters must be strictly adhered to. Alternate manufacturers may be submitted to LP Consulting Engineers, Inc. for review of project compliance. A copy of the approved material data must be on the project site for the Project Inspector prior to the commencement of installation.

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- E. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.
- F. 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.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
  - 2. Sprinkler Wrenches: For each sprinkler type.
- H. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- I. Provide Owner with the following;
  - 1. Manufacturer's literature and instructions describing operation and maintenance of equipment and devices installed.
  - 2. Typewritten chart with identification and location of all access panels serving equipment and valves. Incorporate into Operation & Maintenance (O&M) manual.
  - 3. Typewritten valve schedule indicating valve number, fixture/equipment or areas served by each numbered valve. Incorporate into O&M manual.
  - 4. 8-1/2 x 11 laminated flow diagram showing isolation valve locations, drain valve locations, and system boundaries, where applicable, and attach it to the system riser.
  - 5. Current copy of NFPA 25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.

#### **1.05 QUALITY ASSURANCE**

- A. Maintain one copy of referenced design and installation standard on site.
- B. Conform to UL and/or FM requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- D. Fabrication shop must provide welding certifications and copy of weld stamp. Weld stamp to be provided on all pipe at welds.
- E. Contractor Qualifications: Provide licensed persons employed by sprinkler contractor to perform planning, calculations, layout, installation, and testing of fire protection systems. The following are acceptable:
  - 1. Licensed Professional Engineer
  - 2. National Institute for Certification of Engineering Technologies (NICET) Level III
  - 3. Certified sprinkler designer
- F. Installer Qualifications: Company specializing in performing the work of this section. with minimum five years' experience.
  - 1. Contractor shall be licensed in the State of California for installation of fire protection systems.
  - 2. Installing company must have a valid State of California contractors' license with a C-16 classification.
- G. Equipment and Components: Provide products that bear UL and FM label or marking.
- H. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

#### **1.06 STRUCTURAL DESIGN REQUIREMENTS AND SEISMIC RESTRAINTS**

- A. Fire protection systems and equipment shall be anchored and seismically braced in accordance with all applicable codes and industry standards.
- B. Fire protection systems and equipment shall include, but are not limited to, all piping, valve assemblies, fire pumps, electrical and control panels, conduits and other components.

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- C. For all non-standard installations not detailed in one of the approved systems, the Contractor shall provide details of supports, anchorages and restraints, including attachments to building structure, with supporting calculations all stamped and signed by a licensed professional structural engineer registered in the State of California.

#### **1.07 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.
- B. Reference specification 21 0500 - Common Work Results for Fire Suppression section 1.06 for additional information.

### **PART 2 PRODUCTS - ALL PRODUCTS SHALL CONFORM TO CONTRACT DOCUMENTS INCLUDING APPROVED MATERIAL DATA.**

#### **2.01 SPRINKLER SYSTEM**

- A. Sprinkler System: Provide coverage for building areas noted on Drawings, including all areas, rooms, spaces above and below ceilings, entry ways, overhangs (if applicable), and all other areas requiring sprinkler protection in accordance with NFPA 13.
- B. Occupancy: Office spaces, Corridors, Bathrooms, Classrooms, Dining Areas, and common spaces - Light Hazard; comply with NFPA 13.
- C. Occupancy: Electrical and IT rooms, Janitor closets, Mechanical rooms, Linen closets, storage areas not exceeding shelving 8ft in height - Ordinary hazard, Group 1; comply with NFPA 13.
- D. Occupancy: Specialty Classrooms, and Storage areas with storage not greater than 12ft in height - Ordinary hazard, Group 2; comply with NFPA 13.
- E. Interface system with building fire and smoke alarm system.
- F. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to fire sprinkler riser. Supply no less than two (2) spare sprinklers of each type and temperature rating used on project. Storage cabinet to include a wrench(s) applicable to sprinkler types.

#### **2.02 SPRINKLERS**

- A. Exposed Area Type: Pendant or Upright.
  - 1. Response Type: Quick.
  - 2. Coverage Type: Standard.
  - 3. Finish: Stainless Steel.
  - 4. Fusible Link: Glass bulb type temperature rated for specific area hazard.
  - 5. Manufacturers:
    - a. Tyco Fire Protection Products: [www.tyco-fire.com/#sle](http://www.tyco-fire.com/#sle).
    - b. Viking; [vikinggroupinc.com](http://vikinggroupinc.com).
  - 6. Application: Areas with exposed construction
- B. Guards: stainless steel with style to match the sprinkler head type used.

#### **2.03 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. Zone Control Valves
  - 1. Outside screw and yoke or butterfly, U.L. listed.
  - 2. Valves shall be sealed open using approved seal.
  - 3. Provide weatherproof actuator housing with two single pole double throw switches.
- C. Electric Alarm: Electrically operated red enameled gong with pressure alarm switch.

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1. Manufacturers:
  - a. Potter; www.pottersignal.com; Model PBA-AC
- D. Pressure Gauge:
  1. Pressure gauges shall be 3-1/2", corrosion resistant moving parts, polycarbonate window, and provided with connection not smaller than 1/4" NPT.
  2. Include ball valve with provisions for draining on each pressure gauge.
- E. Test and Drain Valve:
  1. Test and drain valve shall include integral pressure relief valve. Pressure relief valve shall be set to operate at 175 psi or 10 psi in excess of the maximum system pressure, whichever is greater.
- F. Air Relief Valve:
  1. Automatic float type air vent, ball valve with tamper switch, Y-type strainer, and single set of normally closed dry contacts rated 24VAC/DC at 2 Amps, UL 2573 Listed, FM Approved "Automatic Air Release Valve for Sprinkler Systems", rated to 175 psi non-shock water working pressure.
  2. Air release valve shall be installed in an accessible location to permit operation, maintenance, and visual inspection of the status of the valve.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install in accordance with referenced NFPA design and installation standards and adopted fire codes.
- B. Approved documents do not relieve the fire sprinkler contractor of field coordination. It is the fire sprinkler contractors' responsibility to coordinate piping locations with the work of other trades.
- C. Strict adherence to the contract design documents is required. Any deviation from the contract documents requiring additional plan review, hydraulic calculations, structural review or calculations, or seismic calculations, shall be submitted to LP Consulting Engineers, Inc. for review prior to making changes. LP Consulting Engineers, Inc. to provide calculations and updated plans for DSA approval.
- D. Install equipment in accordance with manufacturer's instructions.
- E. Preparation of installation and fabrication drawings is the responsibility of the fire sprinkler contractor.
- F. Systems that are hydraulically calculated must include 1.2 factor for design area.
- G. Hydraulically calculated system shall be designed to a minimum of 10% or 10 psi below the available water flow curve.
- H. Fire Protection System Layout and Installation Drawings:
  1. Contractor shall review Design Drawings and Specifications, and shall provide installation drawings, calculations, and product data sheets.
  2. Layout of fire protection system has been established for the level shown in contract documents, as it relates to structure, and mechanical/electrical systems in building, and must be adhered to. Other layouts shall be produced by Contractor in coordination with building components.
  3. Conceal sprinkler piping above ceilings where possible.
  4. Contractor shall consult with Architect during development of piping layout to avoid conflicts with general appearance. Pipe routing is a critical issue due to attributes of this building.
  5. Contractor shall be responsible to have examined "Reflected Ceiling" drawings as well as Mechanical, Electrical, Piping, Information Technology, Structural and Architectural building plans prior to system layout.
  6. Contractor shall coordinate routing of piping with other trades and Architect.

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7. Contractor shall participate in coordination process and shall not install piping prior to coordination with other trades.
  - I. Locate outside alarm bell on building wall as indicated on Fire Sprinkler Shop Drawings.
  - J. Place pipe runs to minimize obstruction to other work.
  - K. Place piping in concealed spaces above finished ceilings.
  - L. Where pipe is exposed to outside elements, provide galvanized pipe, fittings, and hangers.
  - M. Threaded pipe where exposed threads are present outside, shall be coated with a corrosion resistant paint equal to Rusto-leum.
    1. See specification 21 05 00 for reference.
  - N. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
  - O. All drops to sprinkler heads in finished ceilings shall be side or top takeoffs from the branch line pipe, and shall be centered in ceiling tiles using hard pipe connections.
    1. No bottom takeoffs other than pendent sprinkler heads attaching directly to branch line pipes, shall be permitted.
  - P. 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.
  - Q. Flush entire piping system of foreign matter.
  - R. Install head guards on sprinklers where indicated on the drawing in addition to the following areas:
    1. All electrical and IT rooms without ceilings shall be provided with head guards.
    2. Sprinkler heads below obstructions in all mechanical spaces shall be provided with head guards.
  - S. Hydrostatically test entire system.
  - T. Required test to be witnessed by Fire Marshal.
  - U. Verification of weld inspection required prior to installation of fire sprinkler system.

### **3.02 INTERFACE WITH OTHER PRODUCTS**

- A. Ensure required devices are installed and connected as required to fire alarm system.

**END OF SECTION**

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## SECTION 22 0130 COMMON WORK RESULTS FOR PLUMBING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. This Section includes the following:
  - 1. Piping tube and fitting materials.
  - 2. Pipe joining materials.
  - 3. Transition fittings.
  - 4. Dielectric fittings.
  - 5. Mechanical sleeve seals.
  - 6. Sleeves.
  - 7. Escutcheons.
  - 8. Grout.
  - 9. Equipment installation requirements common to equipment sections.
  - 10. Supports and anchorages.

#### 1.02 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CPVC: Chlorinated polyvinyl chloride plastic.
  - 3. PE: Polyethylene plastic.
  - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

#### 1.03 SUBMITTALS

- A. Product Data: For the following:
  - 1. Transition fittings.
  - 2. Dielectric fittings.
  - 3. Mechanical sleeve seals.
  - 4. Escutcheons.
- B. Welding certificates.

#### 1.04 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

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1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### **1.06 COORDINATION**

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

### **PART 2 - PRODUCTS**

#### **2.01 PIPE, TUBE, AND FITTINGS MATERIALS**

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

#### **2.02 PIPE JOINING MATERIALS**

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
  1. ABS Piping: ASTM D 2235.

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2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

## **2.03 TRANSITION FITTINGS**

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
  1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
  2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
  3. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

## **2.04 DIELECTRIC FITTINGS**

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Refer to individual Division 23 piping Sections for dielectric fittings not listed below.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

## **2.05 MECHANICAL SLEEVE SEALS**

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  2. Pressure Plates: Stainless steel. Include two for each sealing element.
  3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## **2.06 SLEEVES**

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

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- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms for concrete foundation walls below grade.
- F. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## **2.07 ESCUTCHEONS**

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw. Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw. Polished chrome-plated and rough brass.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## **2.08 GROUT**

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi 28-day compressive strength, unless otherwise indicated in the structural drawings.
  - 3. Packaging: Premixed and factory packaged.

## **PART 3 - EXECUTION**

### **3.01 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
  - 1. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
  - 2. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
  - 3. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
  - 4. Install piping to permit valve servicing.
  - 5. Install piping at indicated slopes.
  - 6. Install piping free of sags and bends.
  - 7. Install fittings for changes in direction and branch connections.
  - 8. Install piping to allow application of insulation.
- C. Select system components with pressure rating equal to or greater than system operating pressure.

### **3.02 ESCUTCHEONS**

- A. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:

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- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
- b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
- c. Insulated Piping: One-piece, stamped-steel type with spring clips.
- d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
- e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
- f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
- g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
- h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

### 3.03 PENETRATIONS AND SLEEVES

- A. Sleeves are not required for core-drilled holes.
- B. Permanent sleeves are not required for holes formed by removable PE sleeves.
- C. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
    - d. Seal space outside of sleeve fittings with grout.
  4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- D. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- E. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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- F. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
- G. Verify final equipment locations for roughing-in.
- H. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.04 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
  - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
  - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End Pipe and Fittings: Use butt fusion.
  - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

### 3.05 PIPING CONNECTIONS

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- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### **3.06 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install equipment to allow maximum possible headroom.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Grease fittings shall be installed in accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### **3.07 CONCRETE BASES**

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic requirements as indicated in the California Building Code.
  - 1. Construct concrete bases of dimensions indicated, but not less than 6 inches larger in both directions than supported unit, vibration isolator, or seismic restraint. Verify requirements with equipment anchor bolt edge distances.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section; unless otherwise indicated in structural drawings.

### **3.08 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### **3.09 GROUTING**

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Grout Installation:
  - 1. Clean surfaces that will come into contact with grout.
  - 2. Provide forms as required for placement of grout.
  - 3. Avoid air entrapment during placement of grout.
  - 4. Place grout, completely filling equipment bases.
  - 5. Place grout on concrete bases and provide smooth bearing surface for equipment.

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6. Place grout around anchors.
7. Cure placed grout.

**END OF SECTION 230130 22 0130**

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## SECTION 22 0516 EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

- A. SECTION INCLUDES
  - 1. Flexible-hose packless expansion joints.
  - 2. Metal-bellows packless expansion joints.
  - 3. Rubber packless expansion joints.
  - 4. Pipe loops and swing connections.
  - 5. Alignment guides and anchors.

#### 1.03 RELATED REQUIREMENTS

- A. Section 22 1005 - Plumbing Piping.

#### 1.04 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for 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.
  - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C. Maintenance Data: Include adjustment instructions.

#### 1.06 REGULATORY REQUIREMENTS

- A. Conform to UL (DIR) requirements.

### PART 2 PRODUCTS

#### 2.01 PACKLESS EXPANSION JOINTS

- A. Flexible-Hose Packless Expansion Joints:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flex-Hose Co. Inc.
    - b. Flexicraft Industries.
    - c. Flex Pression Ltd.
    - d. Metraflex, Inc.:
    - e. Unisource Manufacturing, Inc.
  - 2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible metal hose legs joined by long-radius, 180 degree return bend or center section of flexible hose.
  - 3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
  - 4. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.

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- a. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F (4830 kPa at 21 deg C) and 500 psig at 450 deg F (3450 kPa at 232 deg C) ratings
  5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.
    - a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F (2890 kPa at 21 deg C) and 315 psig at 450 deg F (2170 kPa at 232 deg C) ratings.
  6. Expansion Joints for Steel Piping NPS 2 (DN 50) and Smaller: Stainless-steel fittings with threaded end connections.
    - a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F (4830 kPa at 21 deg C) and 515 psig at 600 deg F (3550 kPa at 315 deg C) ratings.
  7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Stainless-steel fittings with flanged end connections.
    - a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F (1900 kPa at 21 deg C) and 200 psig at 600 deg F (1380 kPa at 315 deg C) ratings.
- B. Metal-Bellows Packless Expansion Joints:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flex-Hose Co. Inc.
    - b. Flexicraft Industries.
    - c. Metraflex, Inc.:
    - d. Unisource Manufacturing, Inc.
  2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
  3. Type: Circular, corrugated bellows with external tie rods.
  4. Minimum Pressure Rating: 175 psig (1200 kPa) unless otherwise indicated.
  5. Configuration: Single joint with base and double joint with base class(es) unless otherwise indicated.
  6. Expansion Joints for Copper Tubing: Multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
    - a. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: threaded.
    - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): threaded.
- C. Rubber Packless Expansion Joints:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Amber/Booth, Inc; a div. of Vibration Isolation Products of Texas, Inc.
    - b. Garlock Sealing Technologies.
    - c. General Rubber Corporation.
    - d. Mason Industries, Inc.; Mercer Rubber Co.
    - e. Proco Products, Inc.
    - f. Red Valve Company, Inc.
    - g. Tozen Corporation. :
    - h. Unafelx.
  2. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
  3. Materials: Fabric-reinforced rubber complying with FSA-NMEJ-703.
  4. Arch Type: Single or Multiple arches with external control rods.
  5. Spherical Type: Single or Multiple spheres with external control rods.
  6. Minimum Pressure Rating for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 150 psig (1035 kPa) at 220 deg F (104 deg C).

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7. Material for Fluids Containing Gas, Hydrocarbons, or Oil: Buna-N.
8. Material for Water: Buna-N.
9. End Connections: Full-faced, integral steel flanges with steel retaining rings.

## 2.02 ALIGNMENT GUIDES AND ANCHORS

- A. Alignment Guides:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flex-Hose Co. Inc.
    - b. Flexicraft Industries.
    - c. Flex-Weld, Inc.
    - d. Metraflex, Inc.
    - e. Unisource Manufacturing, Inc.
  2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.
- B. Anchor Materials:
  1. Steel Shapes and Plates: ASTM A 36 / A 36M.
  2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
  3. Washers: ASTM F 844, steel, plain, flat washers.
  4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
    - a. Stud: Threaded, zinc-coated carbon steel.
    - b. Expansion Plug: Zinc-coated steel.
    - c. Washer and Nut: Zinc-coated steel.
  5. Manufacturers:
  6. Mercer Rubber Company: [www.mercer-rubber.com/#sle](http://www.mercer-rubber.com/#sle).
  7. The Metraflex Company: [www.metraflex.com/#sle](http://www.metraflex.com/#sle).

## 2.03 ACCESSORIES

- A. Pipe Alignment Guides:
  1. Manufacturers:
    - a. The Metraflex Company; PGQ Glide Riser Guide: [www.metraflex.com/#sle](http://www.metraflex.com/#sle).
  2. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inches travel.

## PART 3 EXECUTION

### 3.01 EXPANSION-JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- C. Install rubber packless expansion joints according to FSA-NMEJ-702.
- D. Install grooved-joint expansion joints according to grooved-steel piping.

### 3.02 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.

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- D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

### **3.03 ALIGNMENT-GUIDE AND ANCHOR INTALLATION**

- A. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters for expansion joint.
- B. Attach guides to pipe and secure guides to building structure.
- C. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- D. Anchor Attachments:
  - 1. Anchor Attachment to Black-Steel Pipe: Attach by welding. Comply to ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 2. Anchor Attachment to Galvanized-Steel Pipe: Attach by pipe hangers. Use MSS SP-69, Type 42, riser clamp welded to anchor.
  - 3. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted by anchor.
- E. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

### **3.04 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.

**END OF SECTION 22 0516**

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## SECTION 22 0517 SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Pipe sleeves.
- B. Manufactured sleeve-seal systems.

#### 1.02 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 09 9113 - Exterior Painting: Preparation and painting of exterior piping systems.
- C. Section 09 9123 - Interior Painting: Preparation and painting of interior piping systems.
- D. Section 22 0523 - General-Duty Valves for Plumbing Piping.
- E. Section 22 0553 - Identification for Plumbing Piping and Equipment: Piping identification.
- F. Section 22 0716 - Plumbing Equipment Insulation.
- G. Section 22 0719 - 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).
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for 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. Installer Qualifications: Company specializing in performing work of the type specified this section.
  - 1. Minimum three years experience.
  - 2. Approved by manufacturer.
- C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

#### 1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

### PART 2 PRODUCTS

#### 2.01 PIPE SLEEVES

- A. Manufacturers:
  - 1. Flexicraft Industries; Pipe Wall Sleeve: [www.flexicraft.com/#sle](http://www.flexicraft.com/#sle).
- B. Vertical Piping:

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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.
- C. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- D. 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.
- E. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
1. Galvanized steel pipe or black iron pipe with asphalt coating.
  2. Connect sleeve with floor plate except in mechanical rooms.
- F. 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 complying with ASTM E814 in accordance with Section 07 8400 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](http://www.apsonline.com/#sle).
  2. Flexicraft Industries; PipeSeal: [www.flexicraft.com/#sle](http://www.flexicraft.com/#sle).
- 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.
  4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

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5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- E. Structural Considerations:
  1. Do not penetrate building structural members unless indicated.
- F. 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 complying 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 complying with ASTM E814 in accordance with Section 07 8400 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.
- G. 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.
- H. 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.
- C. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

**END OF SECTION 22 0517**

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## SECTION 22 0519 METERS AND GAUGES FOR PLUMBING PIPING

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

- A. Section Includes:
  - 1. Bimetallic-actuated thermometers.
  - 2. Thermowells.
  - 3. Dial-Type pressure gages.
  - 4. Test plugs.
  - 5. Test-plug kits.
- B. Static pressure gauges.

#### 1.03 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers.
- C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.
- D. UL 393 - Indicating Pressure Gauges for Fire-Protection Service.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each type of product indicated.
- C. Product Certificates: For each type of meter and gage, from each manufacturer.
- D. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

#### 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 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work included, but are not limited to, the following:
  - 1. Miljoco Corporation.
  - 2. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  - 3. Weiss Instruments, Inc.
- B. Standard: ASME B40.200.
- C. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch (76-mm) nominal diameter.
- D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg.
- E. Connector Type(s): Union joint, adjustable angle rigid, back and rigid, bottom, with unified-inch screw threads.
- F. Connector Size: 1/2 inch (13-mm), with ASME B1.1 screw threads.
- G. Stem: 0.25 or 0.375 inch (6.4 or 9.4 mm) in diameter; stainless steel.
- H. Window: Plain glass.
- I. Ring: Stainless steel.

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- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 percent of scale range.

## 2.02 THERMOWELLS

- A. Thermowells:
  - 1. Standard: ASME B40.200.
  - 2. Description: Pressure-tight, socket-type fittings made for insertion into piping tee fitting.
  - 3. Material for Use with Copper Tubing: CNR or CUNI.
  - 4. Material for Use with Steel Piping: CSA.
  - 5. Type: Stepped shank unless straight or tapered shank is indicated.
  - 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or DN 25) ASME B1.20.1 pipe threads.
  - 7. Internal Threads: 1/2, 3/4, and 1 inch, (13, 19, or 25 mm) with ASME B1.1 screw threads.
  - 8. Bore: Diameter required to match thermometer bulb or stem.
  - 9. Insertion Length: Length required to match thermometer bulb or stem.
  - 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
  - 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

## 2.03 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Miljoco Corporation.
    - b. Watts Reulator Co.; a div. of Watts Water Technologies, Inc.
  - 2. Standard: ASME B40.100.
  - 3. Case: Sealed type(s); cast aluminum or drawn steel; 4-1/2 inch (114-mm) nominal diameter.
  - 4. Pressure--Element Assembly: Bourdon tube unless otherwise indicated.
  - 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  - 6. Movement: Mechanical, with link to pressure element and connection to pointer.
  - 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa)
  - 8. Pointer: Dark-colored metal.
  - 9. Window: Glass.
  - 10. Ring: Brass.
  - 11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.
- B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Ametek Inc, US Gauge.
    - b. Ashcroft Inc.
    - c. Flo-Flab Inc.
    - d. Marsh Bellofram.
    - e. Miljoco Corporation.
    - f. Noshok.
    - g. Palmer Wahl Instrumentation Group.
    - h. Reotemp Instrument Corporation.

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- i. Tel-Tru Manufacturing Company.
- j. Trerice, H.O. Company.
- k. Weiss Instruments, Inc.
- l. Wika Instrument Corporation - USA.
- m. Winters Instruments - US
- 2. Standard: ASME B40.100.
- 3. Case: Sealed type; plastic; 4-1/2 inch (114-mm) nominal diameter.
- 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
- 6. Movement: Mechanical, with link to pressure element and connection to pointer.
- 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
- 8. Pointer: Dark-colored metal.
- 9. Window: Glass.
- 10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

#### **2.04 GAGE ATTACHMENTS**

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

#### **2.05 TEST PLUGS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work included, but are not limited to, the following:
  - 1. Miljoco Corporation.
  - 2. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  - 3. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

#### **2.06 TEST-PLUG KITS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work included, but are not limited to, the following:
  - 1. Miljoco Corporation.
  - 2. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  - 3. Weiss Instruments, Inc.
- B. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 1 to 2 inch (25 to 51 mm) diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C).
- D. High-Range Thermometer: Small, bimetallic insertion type with 1 to 2 inch (25 to 51 mm) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C).

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- E. Pressure Gage: Small, Bourdon-tube insertion type with 2 to 3 inch (51 to 76 mm) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa).
- F. Carrying Case: Metal or plastic, with formed instrument padding.

## **2.07 PRESSURE GAUGES**

- A. Manufacturers:
  - 1. Dwyer Instruments, Inc: [www.dwyer-inst.com/#sle](http://www.dwyer-inst.com/#sle).
  - 2. Moeller Instrument Company, Inc: [www.moellerinstrument.com/#sle](http://www.moellerinstrument.com/#sle).
  - 3. Omega Engineering, Inc: [www.omega.com/#sle](http://www.omega.com/#sle).
- 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: Steel with brass bourdon tube.
  - 2. Size: 4-1/2 inch diameter.
  - 3. Mid-Scale Accuracy: One percent.
  - 4. Scale: Psi and kPa.

## **2.08 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.

## **2.09 STEM TYPE THERMOMETERS**

- A. Manufacturers:
  - 1. Dwyer Instruments, Inc: [www.dwyer-inst.com/#sle](http://www.dwyer-inst.com/#sle).
  - 2. Omega Engineering, Inc: [www.omega.com/#sle](http://www.omega.com/#sle).
  - 3. Weksler Glass Thermometer Corp: [www.wekslerglass.com/#sle](http://www.wekslerglass.com/#sle).
- 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.
  - 4. Calibration: Degrees F.
- 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. Accuracy: 2 percent, per ASTM E77.
  - 4. Calibration: Degrees F.

## **2.10 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.

## **2.11 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.

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- B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gauges, one gauge adapters with 1/8 inch probes, two 1 inch dial thermometers.

## **2.12 STATIC PRESSURE GAUGES**

- A. Manufacturers:
  - 1. Dwyer Instruments, Inc: [www.dwyer-inst.com/#sle](http://www.dwyer-inst.com/#sle).
  - 2. Omega Engineering, Inc: [www.omega.com/#sle](http://www.omega.com/#sle).
  - 3. Weksler Glass Thermometer Corp: [www.wekslerglass.com/#sle](http://www.wekslerglass.com/#sle).
- 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.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install thermowells with socket extending a minimum of 2 inches (51mm) into fluid and in vertical position in piping tees.
- B. install themowells of sizes required to match thermometer connections. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- F. Install test plugs in piping tees.
- G. Install themometers in the following locations:
  - 1. Inlet and outlet of each water heater.
- H. Intall pressure gages in the following locations:
  - 1. Building water service entrance into the building.
  - 2. Inlet and outlet of each pressure-reducing valve.
  - 3. Suction and discharge of each domestic water pump.

### **3.02 CONNECTIONS**

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

### **3.03 ADJUSTING**

- A. Adjust faces of meters and gages to proper angle for best visibility.

### **3.04 THERMOMETER SCALE-RANGE SCHEDULE**

- A. Scale Range for Domestic Cold Water Piping: 0 - 100 deg F (Minus 20 to plus 50 deg C).
- B. Scale Range for Domestic Hot Water Piping: 0 - 250 deg F (0 to 150 deg C).

### **3.05 PRESSURE-GAGE SCALE-RANGE SCHEDULE**

- A. Scale Range for Domestic Water Piping: 0 - 160 psi (0 to 1100 kPa).
- B. Install in accordance with manufacturer's instructions.

**END OF SECTION 22 0519**

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## SECTION 22 0523 GENERAL-DUTY VALVES FOR PLUMBING PIPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Applications.
- B. General requirements.
- C. Angle valves.
- D. Ball valves.
- E. Butterfly valves.
- F. Check valves.
- G. Gate valves.
- H. Globe valves.
- I. Plug valves.

#### 1.02 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 08 3100 - Access Doors and Panels.
- C. Section 22 0553 - Identification for Plumbing Piping and Equipment.
- D. Section 22 0719 - Plumbing Piping Insulation.
- E. Section 22 1005 - 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.

#### 1.04 REFERENCE STANDARDS

- A. API STD 594 - Check Valves: Flanged, Lug, Wafer, and Butt-Welding.
- B. ASME B1.20.1 - Pipe Threads, General Purpose, Inch.
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- D. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
- E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves.
- F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- G. ASME B16.34 - Valves — Flanged, Threaded, and Welding End.
- H. ASME B31.9 - Building Services Piping.
- I. 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.

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- J. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
- K. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- L. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
- M. ASTM A536 - Standard Specification for Ductile Iron Castings.
- N. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings.
- O. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
- P. MSS SP-45 - Drain and Bypass Connections.
- Q. MSS SP-67 - Butterfly Valves.
- R. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends.
- S. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends.
- T. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service.
- U. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends.
- V. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves.
- W. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.
- X. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- Y. MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided.
- Z. NSF 61 - Drinking Water System Components - Health Effects.
- AA. NSF 372 - Drinking Water System Components - Lead Content.

#### **1.05 SUBMITTALS**

- A. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- B. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
- D. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.

#### **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.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

#### **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.
  - 6. Adjust butterfly valves to closed or partially closed position.

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- 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.

#### **1.08 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:**

- A. Handle large valves with sling, modified to avoid damage to exposed parts.
- B. Avoid the use of operating handles or stems as rigging or lifting points.

### **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. 2-1/2 NPS and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- 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.
  - 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 and Brass: Provide with solder-joint or threaded ends.
    - b. Bronze Angle: Class 125, bronze disc.
    - c. Ball: One piece, full port, brass or bronze 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 or flanged 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.

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- 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. Gear Actuator: Quarter-turn valves 8 NPS and larger.
  - 2. Handwheel: Valves other than quarter-turn types.
  - 3. Hand Lever: Quarter-turn valves 6 NPS and smaller except plug valves.
  - 4. Wrench: Plug valves with square heads.
- 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.
- 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. Valve Materials for Potable Water: NSF 61 and NSF 372.
- H. Bronze Valves:
  - 1. Fabricate from dezincification resistant material.
  - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- I. Valve Bypass and Drain Connections: MSS SP-45.
- J. 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 BRASS BALL VALVES

- A. One-Piece, Reduced-Port with Brass Trim:

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1. Comply with MSS SP-110.
  2. CWP Rating: 400 psig.
  3. CWP Rating: 600 psig.
  4. Body: Forged brass.
  5. Ends: Threaded.
  6. Seats: PTFE or TFE.
  7. Stem: Brass.
  8. Ball: Chrome-plated brass.
- B. Two Piece, Full Port with Brass Trim:
1. Comply with MSS SP-110.
  2. SWP Rating: 150 psig.
  3. CWP Rating: 600 psig.
  4. Body: Forged brass.
  5. Ends: Threaded.
  6. Seats: PTFE.
  7. Stem: Brass.
  8. Ball: Chrome-plated brass.
- C. Three Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
  2. SWP Rating: 150 psig.
  3. CWP Rating: 600 psig.
  4. Body: Forged brass.
  5. Ends: Threaded.
  6. Seats: PTFE or TFE.
  7. Stem: Stainless steel.
  8. Ball: Stainless steel, vented.

## 2.05 BRONZE BALL VALVES

- A. 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: Threaded.
  6. Seats: PTFE or TFE.
  7. Ball: Chrome plated brass.
  8. Manufacturers:
    - a. Viega LLC: [www.viega.com/#sle](http://www.viega.com/#sle).
    - b. Apollo Valves: [www.apollovalves.com](http://www.apollovalves.com)
    - c. Watts: [www.watts.com](http://www.watts.com)
- B. Two Piece, Full Port with Bronze Trim:
1. Comply with MSS SP-110.
  2. SWP Rating: 150 psig.
  3. CWP Rating: 600 psig.
  4. Body: Bronze.
  5. Ends: Threaded.
  6. Seats: PTFE or TFE.
  7. Stem: Bronze.
  8. Ball: Chrome plated brass.
  9. Manufacturers:
    - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
    - b. Viega LLC: [www.viega.com/#sle](http://www.viega.com/#sle).

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c. Watts: [www.watts.com](http://www.watts.com)

- C. Three Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
  2. SWP Rating: 150 psig.
  3. CWP Rating: 600 psig.
  4. Body: Bronze.
  5. Ends: Threaded.
  6. Seats: PTFE or TFE
  7. Stem: Stainless steel.
  8. Ball: Stainless steel, vented.
  9. Manufacturers:
    - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
    - b. Viega LLC: [www.viega.com/#sle](http://www.viega.com/#sle).
    - c. Watts: [www.watts.com](http://www.watts.com)

## 2.06 STAINLESS STEEL BALL VALVES

- A. One-Piece, Standard Port with Stainless-Steel Trim:
1. Comply with MSS SP-110.
  2. SWP Rating: 150 psig.
  3. CWP Rating: 800 psig.
  4. Body: Stainless steel.
  5. Ends: Threaded.
  6. Seats: PTFE.
  7. Stem: Stainless steel.
  8. Ball: Stainless steel.
  9. Manufacturers:
    - a. Viega LLC: [www.viega.com/#sle](http://www.viega.com/#sle).
- B. Two Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
  2. SWP Rating: 150 psig.
  3. CWP Rating: 1000 psig.
  4. Body: Stainless steel.
  5. Seats: PFTE.
  6. Stem: Stainless steel.
  7. Ball: Stainless steel.
  8. Manufacturers:
    - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
    - b. Viega LLC: [www.viega.com/#sle](http://www.viega.com/#sle).
- C. Three Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
  2. SWP Rating: 150 psig.
  3. CWP Rating: 1000 psig.
  4. Body: Stainless steel.
  5. Seats: PFTE.
  6. Stem: Stainless steel.
  7. Ball: Stainless steel.
  8. Bolts: Stainless steel.
  9. Manufacturers:
    - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
    - b. Viega LLC: [www.viega.com/#sle](http://www.viega.com/#sle).

## 2.07 IRON BALL VALVES

- A. Class 125, Full Port, Stainless Steel Trim:

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1. Comply with MSS SP-72.
2. CWP Rating: 200 psig.
3. Body: ASTM A536 Grade 65-45-12, ductile iron.
4. Ends: Flanged.
5. Seats: PTFE or TFE.
6. Stem: Stainless steel.
7. Ball: Stainless steel.
8. Operator: Lever, with locking handle.
9. Manufacturers:
  - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).

## **2.08 IRON, SINGLE FLANGE BUTTERFLY VALVES**

- A. Lug type: Bi-directional dead-end service without use of downstream flange.
  1. Comply with MSS SP-67, Type I.
  2. CWP Rating: 200 psig.
  3. Body: ASTM A126, cast iron or ASTM A536, ductile iron.
  4. Stem: One or two-piece stainless steel.
  5. Seat: EPDM.
  6. Disc: Coated ductile iron.
  7. Manufacturers:
    - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).

## **2.09 IRON, GROOVED-END BUTTERFLY VALVES**

- A. CWP Rating: 175 psig (1200 kPa).
  1. Comply with MSS SP-67, Type I.
  2. Body: Coated ductile iron.
  3. Stem: Two-piece stainless steel.
  4. Disc: Coated ductile iron.
  5. Disc Seal: EPDM.

## **2.10 BRONZE LIFT CHECK VALVES**

- A. Class 125:
  1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc to Metal Seat.
  2. CWP Rating: 200 psig.
  3. Design: Vertical flow.
  4. Body: Comply with ASTM B61 or ASTM B62, bronze.
  5. Ends: Threaded as indicated.
  6. Disc (Type 1): Bronze.
  7. Disc (Type 2): NBR, PTFE, or TFE.

## **2.11 BRONZE SWING CHECK VALVES**

- A. Class 125: CWP Rating: 200 psig (1380 kPa).
  1. Comply with MSS SP-80, Type 3.
  2. Design: Horizontal flow.
  3. Body: Bronze, ASTM B62.
  4. Ends: Threaded as indicated.
  5. Disc: Bronze.
  6. Manufacturers:
    - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).

## **2.12 IRON SWING CHECK VALVES**

- A. Class 125:
  1. Comply with MSS SP-71, Type I.
  2. CWP Rating: 200 psig.

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3. Design: Clear or full waterway.
4. Body: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged as indicated.
6. Trim: Composition.
7. Seat Ring and Disc Holder: Bronze.
8. Disc: PTFE or TFE.
9. Gasket: Asbestos free.
10. Manufacturers:
  - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
  - b. Ferguson Enterprises Inc: [www.fnw.com/#sle](http://www.fnw.com/#sle).
  - c. Flomatic Valves; Flo-Flex Swing Check Valve: [www.flomatic.com/#sle](http://www.flomatic.com/#sle).

B. Class 250:

1. Comply with MSS SP-71, Type I.
2. CWP Rating: 500 psig.
3. Design: Clear or full waterway.
4. Body: ASTM A126, gray iron with bolted bonnet.
5. Ends: Flanged as indicated.
6. Trim: Bronze.
7. Metal Seat.
8. Gasket: Asbestos free.

## 2.13 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125 with Lever and Spring-Closure Control.

1. Comply with MSS SP-71, Type I.
2. Description:
  - a. CWP Rating: 200 psig.
  - b. Design: Clear or full waterway.
  - c. Body: ASTM A126, gray iron with bolted bonnet.
  - d. Ends: Flanged as indicated.
  - e. Trim: Bronze.
  - f. Gasket: Asbestos free.
  - g. Closer Control: Factory installed, exterior lever, and weight.
3. Manufacturers:
  - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
  - b. Flomatic Valves; 90LS/92LS Swing Check Valve: [www.flomatic.com/#sle](http://www.flomatic.com/#sle).

## 2.14 IRON GROOVED-END SWING CHECK VALVES

A. 300 CWP:

1. CWP Rating: 300 psig.
2. Body: ASTM A536, Grade 65-45-12 ductile iron.
3. Seal: EPDM.
4. Disc: Ductile iron.
5. Coating: Black, non-lead paint.

## 2.15 IRON CENTER-GUIDED CHECK VALVES

A. Class 125, Compact-Wafer:

1. Comply with MSS SP-125.
2. CWP Rating: 200 psig.
3. Body: ASTM A126 gray iron.
4. Body: 316 stainless steel.
5. Metal Seat: Unleaded bronze.
6. Metal Seat: Stainless steel.
7. Resilient Seat: EPDM.
8. Manufacturers:

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- a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
  - b. Flomatic Valves; 888S6R Wafer Check Valve: [www.flomatic.com/#sle](http://www.flomatic.com/#sle).
- B. Class 125, Globe:
  - 1. Comply with MSS SP-125.
  - 2. CWP Rating: 200 psig.
  - 3. Body: ASTM A126 gray iron.
  - 4. Body: Stainless steel.
  - 5. Style: Spring loaded.
  - 6. Ends: Flanged.
  - 7. Metal Seat: Unleaded bronze.
  - 8. Metal Seat: Stainless steel.
  - 9. Resilient Seat: EPDM.
  - 10. Manufacturers:
    - a. Flomatic Valves; 402BTR Globe Check Valve: [www.flomatic.com/#sle](http://www.flomatic.com/#sle).
- C. Class 150, Compact-Wafer:
  - 1. Comply with MSS SP-125.
  - 2. CW P Rating: 300 psig.
  - 3. Body: ASTM A395/A395M or ASTM A536, ductile iron.
  - 4. Body: 316 Stainless steel.
  - 5. Metal Seat: Unleaded bronze.
  - 6. Metal Seat: Stainless steel.
  - 7. Resilient Seat: EPDM.
  - 8. Manufacturers:
    - a. Flomatic Valves; 888S6R Wafer Check Valve: [www.flomatic.com/#sle](http://www.flomatic.com/#sle).
- D. Class 150, Globe:
  - 1. Comply with MSS SP-125.
  - 2. CWP Rating: 300 psig.
  - 3. Body: ASTM A395/A395M or ASTM A536, ductile iron.
  - 4. Body: Stainless steel.
  - 5. Style: Spring loaded.
  - 6. Ends: Flanged.
  - 7. Metal Seat: Unleaded bronze.
  - 8. Metal Seat: Stainless steel.
  - 9. Resilient Seat: EPDM.
  - 10. Manufacturers:
    - a. Flomatic Valves; 402S6R Globe Check Valve: [www.flomatic.com/#sle](http://www.flomatic.com/#sle).
- E. Class 250, Compact-Wafer:
  - 1. Comply with MSS SP-125.
  - 2. CWP Rating: 400 psig.
  - 3. Body: ASTM A126, gray iron.
  - 4. Style: Spring loaded.
  - 5. Metal Seat: Unleaded bronze.
  - 6. Resilient Seat: NBR.
- F. Class 250, Globe:
  - 1. Comply with MSS SP-125.
  - 2. 2-1/2 NPS to 12 NPS, CWP Rating: 400 psig.
  - 3. 14 NPS to 24 NPS, CWP Rating: 300 psig.
  - 4. Body Material: ASTM A126, gray iron.
  - 5. Style: Spring loaded.
  - 6. Ends: Flanged.
  - 7. Metal Seat: Unleaded bronze.

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8. Resilient Seat: NBR.
- G. Class 300, Compact-Wafer:
  1. Comply with MSS SP-125.
  2. CWP Rating: 500 psig.
  3. Body: ASTM A395/A395M or ASTM A536, ductile iron.
  4. Style: Spring loaded.
  5. Metal Seat: Unleaded bronze.
  6. Resilient Seat: EPDM.
- H. Class 300, Globe:
  1. Comply with MSS SP-125.
  2. CWP Rating: 500 psig.
  3. Body: ASTM A395/A395M or ASTM A536, ductile iron.
  4. Style: Spring loaded.
  5. Ends: Flanged.
  6. Metal Seat: Unleaded bronze.
  7. Resilient Seat: NBR.

## **2.16 IRON PLATE TYPE CHECK VALVES**

- A. Class 125 Single-Plate:
  1. Comply with API STD 594.
  2. CWP Rating: 200 psig.
  3. Design: Wafer, spring-loaded plate.
  4. Body: ASTM A126, gray iron.
  5. Resilient Seat: EPDM.
- B. Class 125, Dual-Plate:
  1. Comply with API STD 594.
  2. CWP Rating: 200 psig.
  3. Design: Wafer, spring-loaded plates.
  4. Body: ASTM A126, gray iron.
  5. Resilient Seat: EPDM.
- C. Class 150, Dual-Plate:
  1. Comply with API STD 594.
  2. CWP Rating: 300 psig.
  3. Design: Wafer, spring-loaded plates.
  4. Body: ASTM A395/A395M or ASTM A536, ductile iron.
  5. Resilient Seat: NBR.
- D. Class 250, Single-Plate:
  1. Comply with API STD 594.
  2. CWP Rating: 400 psig.
  3. Design: Wafer, spring-loaded plate.
  4. Body: ASTM A126, gray iron.
  5. Resilient Seat: NBR.
- E. Class 250, Dual-Plate:
  1. Comply with API STD 594.
  2. CWP Rating: 400 psig.
  3. Design: Wafer, spring-loaded plates.
  4. Body: ASTM A126, gray iron.
  5. Resilient Seat: NBR.
- F. Class 300, Dual-Plate:
  1. Comply with API STD 594.
  2. CWP Rating: 500 psig.

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3. Design: Wafer, spring-loaded plates.
4. Body: ASTM A395/A395M or ASTM A536, ductile iron.
5. Metal Seat: Bronze.

## 2.17 BRONZE GATE VALVES

- A. Rising Stem (RS):
  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.
  9. Manufacturers:
    - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
    - b. Ferguson Enterprises Inc: [www.fnw.com/#sle](http://www.fnw.com/#sle).

## 2.18 IRON GATE VALVES

- A. OS & Y:
  1. Comply with MSS SP-70, Type I.
  2. Class 125: CWP Rating: 200 psig.
  3. Body: ASTM A126, gray iron with bolted bonnet.
  4. Ends: Flanged.
  5. Trim: Bronze.
  6. Disc: Solid wedge.
  7. Packing and Gasket: Asbestos free.
  8. Manufacturers:
    - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
    - b. Ferguson Enterprises Inc: [www.fnw.com/#sle](http://www.fnw.com/#sle).

## 2.19 BRONZE GLOBE VALVES

- A. 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: Bronze, PTFE, or TFE.
  6. Packing: Asbestos free.
  7. Handwheel: Malleable Iron.
  8. Manufacturers:
    - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).

## 2.20 IRON GLOBE VALVES

- A. Class 125: CWP Rating: 200 psig:
  1. Comply with MSS SP-85, Type I.
  2. Body: Gray iron; ASTM A126, with bolted bonnet.
  3. Ends: Flanged.
  4. Trim: Bronze.
  5. Packing and Gasket: Asbestos free.
  6. Operator: Handwheel or chainwheel.
  7. Manufacturers:
    - a. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).

## 2.21 STAINLESS STEEL GLOBE VALVES

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- A. Class 150: CWP Rating: 300 psig:
  - 1. Comply with ASME B16.34 for pressure-temperature range.
  - 2. Body: 316L stainless steel, with bolted bonnet.
  - 3. Ends: Flanged.
  - 4. Trim: Stainless steel.
  - 5. Packing and Gasket: Asbestos free.
  - 6. Operator: Handwheel.
  - 7. Manufacturers:
    - a. Ferguson Enterprises Inc: [www.fnw.com/#sle](http://www.fnw.com/#sle).

## **2.22 LUBRICATED PLUG VALVES**

- A. Regular Gland and Cylindrical with Flanged Ends:
  - 1. Comply with MSS SP-78, Type II.
  - 2. Class 125: CWP Rating: 200 psig.
  - 3. Class 250: CWP Rating: 400 psig.
  - 4. Body: ASTM A48/A48M or ASTM A126, cast iron with lubrication sealing system.
  - 5. Pattern: Regular or short.
  - 6. Plug: Cast iron or bronze with sealant groove.

## **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.
  - 3. Orient plate-type and center-guided into horizontal or vertical position, between flanges.
- 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 22 0523**

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

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Support and attachment components for equipment, piping, and other plumbing work.

#### 1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 05 5000 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- C. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

#### 1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.
- F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- I. MFMA-4 - Metal Framing Standards Publication.
- J. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

#### 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 3000.

#### 1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, non-penetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

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- B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

## 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.
- 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 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 plumbing 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 wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
  5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
    - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Metal Channel (Strut) Framing Systems:
  1. Manufacturers:
    - a. Cooper B-Line, a division of Eaton Corporation: [www.cooperindustries.com/#sle](http://www.cooperindustries.com/#sle).
    - b. Unistrut, a brand of Atkore International Inc: [www.unistrut.com/#sle](http://www.unistrut.com/#sle).
    - c. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
  2. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
  3. Comply with MFMA-4.
  4. 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.
  5. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
  6. 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.

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- 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. Manufacturers:
    - a. Aeroflex USA, Inc: [www.aeroflexusa.com/#sle](http://www.aeroflexusa.com/#sle).
    - b. Buckaroos, Inc: [www.buckaroos.com/#sle](http://www.buckaroos.com/#sle).
    - c. KB Enterprises: [www.snappitz.com/#sle](http://www.snappitz.com/#sle).
  - 2. 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 phenolic foam insulation surrounded by a 360 degree, PVC jacketing.
  - 3. PVC Jacket:
    - a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
    - b. Minimum Service Temperature: Minus 40 degrees F.
    - c. Maximum Service Temperature: 180 degrees F.
    - d. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
    - e. Thickness: 60 mil.
    - f. Connections: Brush on welding adhesive.
  - 4. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
  - 5. Products:
    - a. Aeroflex USA, Inc; Aerofix-U Pipe Supports: [www.aeroflexusa.com/#sle](http://www.aeroflexusa.com/#sle).
    - b. Buckaroos, Inc; CoolDry: [www.buckaroos.com/#sle](http://www.buckaroos.com/#sle).
- E. Pipe Supports:
  - 1. Manufacturers:
    - a. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
  - 2. 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.
- F. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.
  - 1. Manufacturers:
    - a. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
  - 2. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
  - 3. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- G. Riser Clamps:
  - 1. Manufacturers:
    - a. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
  - 2. Provide copper plated clamps for copper tubing support.
  - 3. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
- H. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.

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1. Manufacturers:
  - a. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
- I. Strut Clamps: Two-piece pipe clamp.
  1. Manufacturers:
    - a. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
- J. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.
  1. Manufacturers:
    - a. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
- K. Pipe Hangers: For a given pipe run use hangers of the same type and material.
  1. Manufacturers:
    - a. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
  2. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
  3. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
- L. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
  1. Manufacturers:
    - a. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
  2. Pipe Diameter 6 inches and Smaller: Provide minimum clearance of 0.16 inch.
  3. Pipe Diameter 8 inches: Provide U-bolts with double nuts providing minimum clearance of 0.28 inch.
  4. Pipe Diameter 8 inches: 0.625 inch U-bolt.
  5. Pipe Diameter 10 inches: 0.75 inch U-bolt.
  6. Pipe Diameter 12 to 16 inches: 0.875 inch U-bolt.
  7. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.
- M. Pipe Alignment Guides: Galvanized steel.
  1. Manufacturers:
    - a. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
  2. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
  3. Pipe Diameter 10 inches and Larger: Roller type.
- N. 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.
  1. Manufacturers:
    - a. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
- O. Non-Penetrating Rooftop Supports for Low-Slope Roofs:
  1. Manufacturers:
    - a. Cooper B-Line, a division of Eaton Corporation: [www.cooperindustries.com/#sle](http://www.cooperindustries.com/#sle).
    - b. Unistrut, a brand of Atkore International Inc: [www.unistrut.com/#sle](http://www.unistrut.com/#sle).
    - c. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
  2. 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.

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3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
  4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
  5. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- P. Anchors and Fasteners:
1. Manufacturers - Mechanical Anchors:
    - a. Hilti, Inc: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
    - b. ITW Red Head, a division of Illinois Tool Works, Inc: [www.itwredhead.com/#sle](http://www.itwredhead.com/#sle).
    - c. Powers Fasteners, Inc: [www.powers.com/#sle](http://www.powers.com/#sle).
    - d. Simpson Strong-Tie Company Inc: [www.strongtie.com/#sle](http://www.strongtie.com/#sle).
  2. Manufacturers - Powder-Actuated Fastening Systems:
    - a. Hilti, Inc: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
    - b. ITW Ramset, a division of Illinois Tool Works, Inc: [www.ramset.com/#sle](http://www.ramset.com/#sle).
    - c. Powers Fasteners, Inc: [www.powers.com/#sle](http://www.powers.com/#sle).
    - d. Simpson Strong-Tie Company Inc: [www.strongtie.com/#sle](http://www.strongtie.com/#sle).
  3. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
  4. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
  5. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
  6. Hollow Masonry: Use toggle bolts.
  7. Hollow Stud Walls: Use toggle bolts.
  8. Steel: Use beam clamps, machine bolts, or welded threaded studs.
  9. Sheet Metal: Use sheet metal screws.
  10. Plastic and lead anchors are not permitted.
  11. Powder-actuated fasteners are not permitted.
  12. Hammer-driven anchors and fasteners are not permitted.
  13. 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 gage, 0.1046 inch minimum base metal thickness.
    - d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
  14. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
- Q. Pipe Installation Accessories:
1. Copper Pipe Supports:
    - a. Manufacturers:
      - 1) HoldRite, a brand of Reliance Worldwide Corporation: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).
      - 2) Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by a single manufacturer.
  2. Thermal Insulated Pipe Supports:
    - a. Manufacturers:
      - 1) HoldRite, a brand of Reliance Worldwide Corporation: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).
      - 2) Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by a single manufacturer.
  3. Overhead Pipe Supports:
    - a. Manufacturers:
      - 1) HoldRite, a brand of Reliance Worldwide Corporation: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).
      - 2) Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by a single manufacturer.

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4. Plenum Pipe Supports:
  - a. Manufacturers:
    - 1) HoldRite, a brand of Reliance Worldwide Corporation: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).
    - 2) Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by a single manufacturer.
5. Telescoping Pipe Supports:
  - a. Manufacturers:
    - 1) HoldRite, a brand of Reliance Worldwide Corporation: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).
    - 2) Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by a single manufacturer.
6. Inserts and Clamps:
  - a. Manufacturers:
    - 1) HoldRite, a brand of Reliance Worldwide Corporation: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).
    - 2) Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by a single manufacturer.

## **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. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- H. 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.
- I. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- J. Secure fasteners according to manufacturer's recommended torque settings.
- K. Remove temporary supports.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.

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- 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 22 0529**

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## SECTION 22 0548 VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Seismic restraint systems.

#### 1.02 RELATED REQUIREMENTS

- A. Section 01 4533 - Code-Required Special Inspections and Procedures.
- B. Section 21 0548 - Vibration and Seismic Controls for Fire Suppression Piping and Equipment.
- C. Section 22 0529 - Hangers and Supports for Plumbing Piping and Equipment.

#### 1.03 DEFINITIONS

- A. Plumbing Component: Where referenced in this section in regards to seismic controls, applies to any portion of the plumbing system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g. piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

#### 1.04 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- B. Product Data:
- C. ASCE 19 - Structural Applications of Steel Cables for Buildings.
  - 1. Provide manufacturer's product literature documenting compliance with PART 2 PRODUCTS.
  - 2. Include seismic rating documentation for each isolator and restraint component accounting for horizontal, vertical, and combined loads.

#### 1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment 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.
- B. Sequencing:
  - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

#### 1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Perform design and installation in accordance with applicable codes.
- C. Shop Drawings - Vibration Isolation Systems:
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.
  - 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.

#### 1.07 MANUFACTURERS

- A. Kinetics Noise Control, Inc: [www.kineticsnoise.com/#sle](http://www.kineticsnoise.com/#sle).
- B. Mason Industries: [www.mason-ind.com/#sle](http://www.mason-ind.com/#sle).

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- C. Vibration Eliminator Company, Inc: [www.veco-nyc.com/#sle](http://www.veco-nyc.com/#sle).

## **1.08 PERFORMANCE REQUIREMENTS**

- A. Structural Bases:
- B. Concrete Inertia Bases:
- 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.

## **1.09 QUALITY ASSURANCE**

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

## **1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## **PART 2 PRODUCTS**

### **2.01 INSTALLATION - GENERAL**

- A. Install in accordance with manufacturer's instructions.
- B. Bases:
  - 1. Set steel bases for one inch clearance between housekeeping pad and base.
  - 2. Set concrete inertia bases for 2 inches clearance between housekeeping pad and base.
- C. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- D. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- E. Support piping connections to equipment mounted on isolators using isolators or resilient hangers for scheduled distance.
  - 1. Up to 4 Inches Pipe Size: First three points of support.
  - 2. 5 to 8 Inches Pipe Size: First four points of support.
  - 3. 10 inches Pipe Size and Over: First six points of support.
  - 4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

### **2.02 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES**

- A. Inspect isolated equipment after installation and submit report. Include static deflections.

## **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 CODE-REQUIRED SPECIAL INSPECTIONS**

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 01 4533 and statement of special inspections as required by applicable building code.

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- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
  - 1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
  - 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
- D. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

### **3.03 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.

### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

**END OF SECTION 22 0548**

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## SECTION 22 0553 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

- A. SECTION INCLUDES
  - 1. Equipment Labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Valve tags.
  - 5. Ceiling tacks.
  - 6. Warning tags.

#### 1.03 RELATED REQUIREMENTS

- A. Section 09 9123 - Interior Painting: Identification painting.

#### 1.04 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems.

#### 1.05 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedule: For each piping system to include in maintenance manuals.
- F. Project Record Documents: Record actual locations of tagged valves.

#### 1.06 COORDINATION

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

### PART 2 PRODUCTS

#### 2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, 0.032 inch (0.8 mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
  - 3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 4. Fasteners: Stainless steel rivets or self-tapping screws.
  - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:

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1. Material and Thickness Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
  2. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
  3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
  4. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  5. Fasteners: Stainless steel rivets or self-tapping screws.
  6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2 by 11 inch (A4) bond paper. Tabulate equipment identification number and identify drawing numbers where equipment is indicated (plans, details, and schedules), plus Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.02 WARNING SIGNS AND LABELS

- A. Material and Thickness Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- D. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- E. Fasteners: Stainless steel rivets or self-tapping screws.
- F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- G. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.03 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on drawings, pipe size, and an arrow indicating flow direction.
  1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  2. Lettering Size: At least 1-1/2 inches (38 mm) high.

## 2.04 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4 inch (6.4 mm) letters for piping system abbreviation and 1/2 inch (13 mm) numbers.
  1. Tag Material: Brass, 0.032 inch (0.8 mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.

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2. Fasteners: Bras wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2 by 11 inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve tag schedule shall be included in operation and maintenance data.

## **2.05 WARNING TAGS**

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  1. Size: Approximately 4 by 7 inches (100 by 178 mm).
  2. Fasteners: Brass grommet and wire.
  3. Nomenclature: Large-size primary caption such as "DANGER", "CAUTION", or "DO NOT OPERATE".
  4. Color: Yellow background with black lettering.

## **2.06 IDENTIFICATION APPLICATIONS**

- A. Piping: Tags.
- B. Pumps: Nameplates.
- C. Valves: Tags and ceiling tacks where located above lay-in ceiling.

## **2.07 NAMEPLATES**

- A. Manufacturers:
  1. Brimar Industries, Inc: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  2. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  3. Seton Identification Products: [www.seton.com/#sle](http://www.seton.com/#sle).
- B. Description: Laminated three-layer plastic with engraved letters.
  1. Letter Color: White.
  2. Letter Height: 1/2 inch.
  3. Background Color: Black.
  4. Plastic: Comply with ASTM D709.

## **2.08 TAGS**

- A. Manufacturers:
  1. Advanced Graphic Engraving: [www.advancedgraphicengraving.com/#sle](http://www.advancedgraphicengraving.com/#sle).
  2. Brady Corporation: [www.bradycorp.com/#sle](http://www.bradycorp.com/#sle).
  3. Brimar Industries, Inc: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  4. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  5. Seton Identification Products: [www.seton.com/#sle](http://www.seton.com/#sle).
- 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.

## **2.09 PIPE MARKERS**

- A. Manufacturers:
  1. Brady Corporation: [www.bradycorp.com/#sle](http://www.bradycorp.com/#sle).
  2. Brimar Industries, Inc: [www.pipemarker.com/#sle](http://www.pipemarker.com/#sle).
  3. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
  4. MIFAB, Inc: [www.mifab.com/#sle](http://www.mifab.com/#sle).
  5. Seton Identification Products: [www.seton.com/#sle](http://www.seton.com/#sle).
- B. Comply with ASME A13.1.

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- 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. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.
- F. Color code as follows:
  - 1. Potable, Cooling, Boiler, Feed, Other Water: Green with white letters.
  - 2. Fire Quenching Fluids: Red with white letters.
  - 3. Toxic and Corrosive Fluids: Orange with black letters.

## **2.10 CEILING TACKS**

- A. Manufacturers:
  - 1. Craftmark: [www.craftmarkid.com/#sle](http://www.craftmarkid.com/#sle).
- B. Description: Steel with 3/4 inch diameter color coded head.
- C. Color code as follows:
  - 1. Plumbing Valves: Green.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.
- B. Degrease and clean surfaces to receive adhesive for identification materials.

### **3.02 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### **3.03 PIPE LABEL INSTALLATION**

- A. Piping Color-Coding: Painting of piping is specified in other sections.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces, machine rooms, accessible maintenance spaces such as shafts, tunnels, and plenums, and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet ( 15m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately space labels.

### **3.04 VALVE-TAG INSTALLATION**

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar rough-in connections on end-use fixtures and units. List tagged valves in a valve schedule.

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- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  - 1. Valve-Tag Size and Shape:
    - a. Cold Water: 2 inches (50 mm) round.
    - b. Hot Water: 2 inches (50 mm) round.

### **3.05 WARNING-TAG INSTALLATION**

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

### **3.06 INSTALLATION**

- A. Install plastic 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.
- 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.

**END OF SECTION 22 0553**

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## SECTION 22 0719 PLUMBING PIPING INSULATION

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

- A. Section Includes:
  - 1. Insulation Materials:
    - a. Flexible elastomeric.
    - b. Mineral fiber.
  - 2. Adhesives.
  - 3. Sealants.

#### 1.03 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 09 9123 - Interior Painting: Painting insulation jacket.
- C. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

#### 1.04 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
- F. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- G. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- C. Qualification Data: For qualified installer.
- D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- E. Field quality-control reports.

#### 1.06 QUALITY ASSURANCE

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- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years of experience.

#### **1.07 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed work.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### **1.09 COORDINATION**

- A. Coordinate clearance requirements with piping installer for piping insulation application and equipment installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

#### **1.10 SCHEDULING**

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

#### **1.11 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 INSULATION MATERIALS**

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- C. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.
- D. Flexible Elastomeric: Closed-cell, sponge or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:

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- a. Aeroflex USA Inc; Aerocel.
  - b. Armacell LLC; AP Armaflex.
  - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- E. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fibrex Insulations Inc; Coreplus 1200.
    - b. Johns Manville; Micro-Lok.
    - c. Knauf Insulation; 1000 Pipe Insulation.
    - d. Manson Insulation Inc; Alley-K
    - e. Owens Corning; Fiberglass Pipe Insulation.

## 2.02 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class 1.
  - 1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. PVC Jacket Adhesive: Compatible with PVC Jacket:
  - 1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.03 SEALANTS

- A. Joint Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Permanently flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
  - 4. Color: White or gray.
  - 5. For indoor applications, use sealants that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. FSK and Metal Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire and water resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
  - 4. Color: Aluminum.
  - 5. For indoor applications, use sealants that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire and water resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
  - 4. Color: White.
  - 5. For indoor applications, use sealants that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.04 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.

## 2.05 GLASS FIBER

- A. Manufacturers:

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1. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
  2. Johns Manville Corporation: [www.jm.com](http://www.jm.com).
  3. Knauf Insulation: [www.knaufusa.com](http://www.knaufusa.com).
  4. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
  5. Substitutions: See Section 01 6000 - Product Requirements.
- 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: 220 degrees F.
  3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. 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.

## 2.06 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
1. Aeroflex USA, Inc: [www.aeroflexusa.com](http://www.aeroflexusa.com).
  2. Armacell LLC: [www.armacell.us](http://www.armacell.us).
  3. K-Flex USA LLC: [www.kflexusa.com](http://www.kflexusa.com).
  4. Substitutions: See Section 01 6000 - Product Requirements.
- 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: 220 degrees F.
  3. Connection: Waterproof vapor barrier adhesive.

## 2.07 JACKETS

- A. PVC Plastic.
1. Manufacturers:
    - a. Johns Manville Corporation: [www.jm.com/#sle](http://www.jm.com/#sle).
- B. PVC Jacket: One piece molded type fitting covers and sheet material, off-white color.
1. Minimum Service Temperature: 0 degrees F.
  2. Maximum Service Temperature: 150 degrees F.
  3. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
  4. Thickness: 10 mil.
  5. Connections: Brush on welding adhesive.
  6. Covering Adhesive Mastic: Compatible with insulation.
- C. 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. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
  5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
1. Verify that system and equipment to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry, with foreign material removed.

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3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and dry surfaces to receive insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces, free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thickness required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachments devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesive, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3 inch (75 mm) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) O.C.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) O.C.
  - 4. For below ambient services, apply vapor-barrier mastic over staples.

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5. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Name plates and data plates.
  4. Manholes.
  5. Handholes.
  6. Cleanouts.

### 3.04 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetration.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulations, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations for fire-rated walls and partitions.
1. Comply with requirements for firestopping and fire-resistive joint sealers listed in other sections.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements for firestopping and fire-resistive joint sealers listed in other sections.

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3. General pipe insulation installation.
- G. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- H. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
  2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves with preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers with preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "UNION". Match size and color of pipe labels.
- I. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- J. Install removable insulation covers at locations indicated. Installation shall conform to the following:
  1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of the flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

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3. Construct removeable valveinsulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.05 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flange and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allows passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allows passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allows passage of air to surface being insulated.

### 3.06 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
  1. Secure each layer of performed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) O.C.
  4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
  1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

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3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight piping segments with mineral-fiber blanket insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm) and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
  3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  4. Install insulation to flanges as specified for flange insulation application.

### 3.07 FINISHES

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add Fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.08 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform test and inspections.
- C. Tests and Inspections:
1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to on location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
  2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations for threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Pipe Insulation Schedule, General" Article.

### 3.09 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.

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2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personal injury.

### 3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water:
  1. NPS 1 (DN 25) and Smaller: Insulation shall be one of the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
  2. NPS 1-1/4 (DN 32) and Larger: Insulation shall be one of the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch (38 mm) thick.
- B. Condensate and Equipment Drain Water below 60 Deg F (16 deg C):
  1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 1 inch (25 mm) thick.

### 3.11 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- F. 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.
- G. 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.
- H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.
- I. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with aluminum jacket.
- J. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

**END OF SECTION 22 0719**

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## SECTION 22 1005 PLUMBING PIPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Pipe, pipe fittings, specialties, and connections for piping systems.
  - 1. Sanitary sewer.
  - 2. Sanitary Vent.
  - 3. Domestic water.
  - 4. Storm water.
  - 5. Flanges, unions, and couplings.
  - 6. Pipe hangers and supports.
  - 7. Manufactured sleeve-seal systems.
  - 8. Valves.
  - 9. Flow controls.
  - 10. Check.
  - 11. Water pressure reducing valves.
  - 12. Relief valves.
  - 13. Strainers.
  - 14. Indirect and Condensate

#### 1.02 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 08 3100 - Access Doors and Panels.
- C. Section 09 9123 - Interior Painting.
- D. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- E. Section 22 0553 - Identification for Plumbing Piping and Equipment.
- F. Section 22 0719 - Plumbing Piping Insulation.
- G. Section 31 2316 - Excavation.
- H. Section 31 2316.13 - Trenching.
- I. Section 31 2323 - Fill.
- J. Section 33 0110.58 - Disinfection of Water Utility Piping Systems.

#### 1.03 REFERENCE STANDARDS

- A. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- E. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV.
- F. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
- G. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings - DWV.
- H. ASME B31.9 - Building Services Piping.
- I. 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.
- J. ASSE 1003 - Performance Requirements for Water Pressure Reducing Valves for Potable Water Distribution Systems.

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- K. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- L. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
- M. ASTM B32 - Standard Specification for Solder Metal.
- N. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
- O. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- P. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
- Q. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV).
- R. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
- S. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
- T. ASTM D2321- Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- U. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.
- V. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
- W. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
- X. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
- Y. 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.
- Z. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- AA. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- BB. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.
- CC. AWWA C651 - Disinfecting Water Mains.
- DD. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- EE. 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.
- FF. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements.
- GG. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements.
- HH. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.
- II. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- JJ. NSF 61 - Drinking Water System Components - Health Effects.
- KK. NSF 372 - Drinking Water System Components - Lead Content.

#### **1.04 SUBMITTALS**

- A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

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- B. Welder Certificate: Include welders certification of compliance with ASME BPVC-IX.
- C. Product Origin: Each pipe and fitting shall be marked with the following: Manufacturer's name or registered trademark, Country of Origin, date of manufacture (pipe materials only).
- D. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.

#### **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.
- F. Made in USA: All piping products shall be manufactured and fabricated in the United States and produced from materials that is made and melted in the United States.

#### **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.

#### **1.07 FIELD CONDITIONS**

- A. Do not install underground piping when bedding is wet or frozen.

### **PART 2 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.

#### **2.02 SANITARY SEWER AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING**

- A. Hubless Cast Iron Pipe and Fittings:
  - 1. Pipe Fittings: ASTM A 888 or CISPI 301.
  - 2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
  - 3. Shielded Couplings: ASTM C 1540 assembly of metal shield or housing, corrosion-resistant fasteners and rubber sleeve with integral, center pipe stop.
    - a. Sanitary Sewer And Vent Piping - Heavy-Duty, 4-band shielded, stainless-steel couplings, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
- B. DWV Copper Pipe And Fittings - Forced Main:
  - 1. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
  - 2. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. 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.
- D. Copper Tube: ASTM B88 (ASTM B88M), Type K (A).
  - 1. Fittings: ASME B16.23, cast copper, or ASME B16.29, wrought copper.

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2. Joints: ASTM B32, alloy Sn50 solder.

### **2.03 SANITARY SEWER AND VENT PIPING, ABOVE GRADE**

- A. Hubless Cast Iron Pipe and Fittings:
  1. Pipe Fittings: ASTM A 888 or CISPI 301.
  2. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners and rubber sleeve with integral, center pipe stop.
    - a. Vent Piping - Standard, 2-band or 4-band shielded, stainless-steel couplings, CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
  3. Shielded Couplings: ASTM C 1540 assembly of metal shield or housing, corrosion-resistant fasteners and rubber sleeve with integral, center pipe stop.
    - a. Sanitary Sewer Piping - Heavy-Duty, 4-band shielded, stainless-steel couplings, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
- B. Copper Tube And Fittings - Forced Main:
  1. Hard Drawn Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
  2. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

### **2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING**

- A. Copper Pipe: ASTM B42, hard drawn.
  1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
- B. Copper Tube and Fittings:
  1. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
  2. Wrought-Copper Solder-Joint Fittings: ASME B 16.22, wrought-copper pressure fittings.
  3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
  4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- C. Soft Copper Tube: ASTM B88, Type K water tube, annealed temper.
  1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

### **2.05 DOMESTIC WATER PIPING, ABOVE GRADE**

- A. Copper Tube and Fittings:
  1. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
  2. Wrought-Copper Solder-Joint Fittings: ASME B 16.22, wrought-copper pressure fittings.
  3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
  4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
  1. Mechanical Press Sealed Fittings: Double pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, non toxic synthetic rubber sealing elements.
    - a. Manufacturers:
      - 1) Viega LLC: [www.viega.com/#sle](http://www.viega.com/#sle).

### **2.06 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING**

- A. Hubless Cast Iron Pipe and Fittings:
  1. Pipe Fittings: ASTM A 888 or CISPI 301.
  2. Shielded Couplings: ASTM C 1540 assembly of metal shield or housing, corrosion-resistant fasteners and rubber sleeve with integral, center pipe stop.
    - a. Heavy-Duty, 4-band shielded, stainless-steel couplings, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

### **2.07 STORM WATER PIPING, ABOVE GRADE**

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- A. Hubless Cast Iron Pipe and Fittings:
  - 1. Pipe Fittings: ASTM A 888 or CISPI 301.
  - 2. Shielded Couplings: ASTM C 1540 assembly of metal shield or housing, corrosion-resistant fasteners and rubber sleeve with integral, center pipe stop.
    - a. Heavy-Duty, 4-band shielded, stainless-steel couplings, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

## 2.08 NATURAL GAS PIPING, BURIED BEYOND 5 FEET OF BUILDING

- A. Polyethylene Pipe: ASTM D2513, SDR 11.
  - 1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
  - 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11 and steel pipe complying with:
    - a. ASTM A106 or A53, hot-dipped galvanized steel, Schedule 40, Type E, Grade B for sizes 1/2" - 1-1/2".
    - b. ASTM A53, black steel, Schedule 40, Type E, Grade B for sizes 2" - 8".
  - 3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
    - b. Casing: Steel pipe with corrosion-protective coating covering and complying with:
      - 1) ASTM A106 or A53, hot-dipped galvanized steel, Schedule 40, Type E, Grade B for sizes 1/2" - 1-1/2".
      - 2) ASTM A53, black steel, Schedule 40, Type E, Grade B for sizes 2" - 8".
    - c. Aboveground Portion: PE Transition fitting.
    - d. Outlet shall be threaded or flanged or suitable for welded connection.
    - e. Tracer wire connection.
    - f. Ultraviolet shield.
    - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
  - 4. Transition Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe with corrosion-protective coating covering for aboveground and complying with:
      - 1) ASTM A106 or A53, hot-dipped galvanized steel, Schedule 40, Type E, Grade B for sizes 1/2" - 1-1/2".
      - 2) ASTM A53, black steel, Schedule 40, Type E, Grade B for sizes 2" - 8".
    - b. Outlet shall threaded or flanged or suitable for welded connection.
    - c. Bridging sleeve over mechanical coupling.
    - d. Factory-connected anode.
    - e. Tracer wire connection.
    - f. Ultraviolet shield.
    - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
  - 5. Plastic Mechanical Couplings, NPS 1-1/2" and Smaller: Capable of joining PE pipe to PE pipe.
    - a. PE body with molded-in, stainless-steel support ring.
    - b. Buna-nitrile seals.
    - c. Acetal collets.
    - d. Electro-zinc-plated steel stiffener.
  - 6. Plastic Mechanical Couplings, NPS 2 and Larger: Capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
    - a. Fiber-reinforced plastic body.
    - b. PE body tube.
    - c. Buna-nitrile seals.
    - d. Acetal collets.
    - e. Stainless-steel bolts, nuts, and washers.

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7. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
  - a. Stainless-steel flanges and tube with epoxy finish.
  - b. Buna-nitrile seals.
  - c. Stainless-steel bolts, washers, and nuts.
  - d. Factory-installed anode for steel-body couplings installed underground.

## **2.09 NATURAL GAS PIPING, ABOVE GRADE**

- A. Pipe And Fittings - Interior:
  1. ASTM A53, Type F, Grade A, Black Steel, Schedule 40
    - a. Thread pipe with tapered pipe threads complying with ASME B1.20.1
  2. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    - a. Material Group: 1.1.
    - b. End Connections: Threaded or butt welding to match pipe.
    - c. Lapped Face: Not permitted underground.
    - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
- B. Pipe And Fittings - Exterior:
  1. ASTM A53, Type F, Grade A, Hot-Dip Galvanized , Schedule 40
    - a. Thread pipe with tapered pipe threads complying with ASME B1.20.1
    - b. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
      - 1) Alkyd System: MPI EXT 5.1D.
        - (a) Prime Coat: Alkyd anticorrosive metal primer.
        - (b) Intermediate Coat: Exterior alkyd enamel matching topcoat.
        - (c) Topcoat: Exterior alkyd enamel (semigloss).
        - (d) Color: Gray.
  2. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    - a. Material Group: 1.1.
    - b. End Connections: Threaded or butt welding to match pipe.
    - c. Lapped Face: Not permitted underground.
    - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

## **2.10 ENCASEMENT FOR UNDERGROUND PIPING**

- A. High density cross laminated polyethylene film intended for encasement of underground piping for protection against corrosion.
  1. ASTM 1674 or AWWA C105
  2. Minimum thickness: 0.004-inch
  3. Form: Tube
  4. Color: Natural

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## 2.11 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 Inches and Under:
  - 1. Ferrous pipe: ASME B16.39, Class 150 malleable iron threaded unions.
  - 2. Copper tube and pipe: Class 150 bronze unions with soldered joints.
- B. Flanges for Pipe Size Over 1 Inch:
  - 1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
  - 2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

## 2.12 CONDENSATE PIPING

- A. Copper Tube And Fittings:
  - 1. Hard Drawn Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
  - 2. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

## 2.13 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. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
  - 3. Trapeze Hangers: Welded steel channel frames attached to structure.
  - 4. Vertical Pipe Support: Steel riser clamp.
  - 5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
- B. Plumbing Piping - Drain, Waste, and Vent:
  - 1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
  - 2. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
  - 3. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
  - 4. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
  - 5. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - 6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- C. Plumbing Piping - Water:
  - 1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
  - 2. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
  - 3. Hangers for Hot Pipe Sizes 2 Inches to 4 Inches: Carbon steel, adjustable, clevis.
  - 4. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron pipe roll, double hanger.
  - 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
  - 6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
  - 7. Wall Support for Hot Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
  - 8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - 9. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
  - 10. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.

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11. Copper Pipe Support: Carbon steel ring, adjustable, copper plated, plastic-coated, or felt-lined for non-insulated copper pipe.
- D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
  1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
  2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
  3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
  4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.

## **2.14 MANUFACTURED SLEEVE-SEAL SYSTEMS**

- A. Manufacturers:
  1. The Metraflex Company; MetraSeal: [www.metraflex.com/#sle](http://www.metraflex.com/#sle).
- 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.

## **2.15 BRONZE GATE VALVES**

- A. Bronze Gate Valve, General: MSS SP-80, with ferrous-alloy handwheel.
- B. Type 2, Class 200, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge and union-ring bonnet.

## **2.16 BRONZE GLOBE VALVES**

- A. Bronze Globe Valve, General: MSS SP-80, with ferrous-alloy handwheel.
- B. Type 1, Class 200, Bronze Globe Valves: Bronze body with bronze disc and union-ring bonnet.
- C. Type 2, Class 200, Bronze Gate Valves: Bronze body with PTFE or TFE disc and union-ring bonnet.

## **2.17 BALL VALVES**

- A. General Duty: Copper-Alloy Ball Valves:
  1. Copper-Alloy Ball Valves, General: MSS SP-110
  2. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball, PTFE or TFE seats, and 600 psig (4140 kPa) minimum CWP rating and blowout-proof stem.
  3. Threaded end connection for NPS 2 inch and smaller.
  4. Flanged end connection for NPS 2-1/2 inch and larger.
- B. General Duty: Ferrous-Alloy Ball Valves:
  1. Ferrous-Alloy Ball Valves, General: MSS SP-72, with flange ends.
  2. Ferrous-Alloy Ball Valves: Class 300, full or regular port.
  3. Threaded end connection for NPS 2 inch and smaller.
  4. Flanged end connection for NPS 2-1/2 inch and larger.
- C. Gas Service: Bronze Ball Valves, NPS 2 inch and smaller:
  1. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110
  2. Body: Bronze, complying with ASTM B 584.
  3. Ball: Chrome-plated bronze.
  4. Stem: Bronze, blowout proof.
  5. Seats: Reinforced TFE, blowout proof.
  6. Ends: Threaded, NPS 2 inch and smaller.
  7. CWP Rating: 600 psig (4140 kPa).
  8. Listing: Valves NPS 1 inch and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.

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9. Service for aboveground: Suitable for natural-gas service with "WOG" indicated on valve body.
- D. Gas Service: PE Ball Valve, complying with ASME B16.40.
  1. Body: PE
  2. Ball: PE
  3. Stem: Acetal.
  4. Seats and Seals: Nitrile.
  5. Ends: Plain or fusible to match piping.
  6. CWP Rating: 80 psig (552 kPa).
  7. Operating Temperature: Minus 20 to plus 140 deg F (Minus 29 to plus 60 deg C).
  8. Operator: Nut or flat head for key operation.
  9. Include plastic valve extension.
  10. Include tamperproof locking feature for valves where indicated on Drawings.
  11. Service for underground.

## 2.18 PLUG VALVES

- A. General Duty: Cast-Iron Plug Valves:
  1. Cast-Iron Plug Valves, General: MSS SP-78.
  2. Class 250 or 300, lubricated-type, cast-iron plug valves.
  3. Class 250, nonlubricated-type, cast-iron plug valves.
- B. Gas Service: Bronze Plug Valves: MSS SP-78, NPS 2-1/2 inch and larger.
  1. Body: Bronze, complying with ASTM B 584.
  2. Plug: Bronze.
  3. Ends: Threaded, socket, or flanged.
  4. Operator: Square head or lug type with tamperproof feature where indicated.
  5. Pressure Class: 125 psig (862 kPa).
  6. Listing: Valves NPS 1 inch and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  7. Service for aboveground: Suitable for natural-gas service with "WOG" indicated on valve body.

## 2.19 FERROUS-ALLOY BUTTERFLY VALVES

- A. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.
- B. Flangeless, 250-psig (1725 kPa) CWP Rating, Ferrous-Alloy Butterfly Valve: Wafer type with one or two piece stem.
- C. Single-Flange, 300-psig (2070 kPa) CWP Rating, Ferrous-Alloy Butterfly Valve: Wafer-lug type with one or two piece stem.
- D. Flanged, 300-psig (2070 kPa) CWP Rating, Ferrous-Alloy Butterfly Valve: Flanged-end type with one or two piece stem

## 2.20 SPRING LOADED, LIFT-DISC CHECK VALVES

- A. Lift-Disc Check Valves, General: FCI 74-1, with spring-loaded bronze or alloy disc and bronze or alloy seat.
- B. Type II, Class 250, Compact Wafer, Lift-Disc Check Valves: Compact-wafer style with cast-iron shell with diameter made to fit within bolt circle.
- C. Type III, Class 250, Globe Lift-Disc Check Valves: Globe Style with cast iron shell and flanged ends.
- D. Type IV, Class 150, Threaded Lift-Disc Check Valves: Threaded style with bronze shell and threaded ends.

## 2.21 WATER PRESSURE REDUCING VALVES

- A. Manufacturers:

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1. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
  2. Cla-Val Company: [www.cla-val.com/#sle](http://www.cla-val.com/#sle).
  3. Watts Regulator Company: [www.wattsregulator.com/#sle](http://www.wattsregulator.com/#sle).
  4. American Meter Company
  5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Up to 2 Inches:
1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.
- C. Over 2 Inches:
1. ASSE 1003, cast iron body with interior lining complying with AWWA C550, bronze fitted, elastomeric diaphragm and seat disc, flanged.

## 2.22 RELIEF VALVES

- A. Pressure:
1. Manufacturers:
    - a. Cla-Val Co: [www.cla-val.com/#sle](http://www.cla-val.com/#sle).
    - b. Watts Regulator Company: [www.wattsregulator.com/#sle](http://www.wattsregulator.com/#sle).
  2. ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.
- B. Temperature and Pressure:
1. Manufacturers:
    - a. Watts Regulator Company: [www.wattsregulator.com/#sle](http://www.wattsregulator.com/#sle).
  2. ANSI Z21.22, AGA certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME BPVC-IV certified and labelled.

## 2.23 STRAINERS

- A. Size 2 inch and Under:
1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
  2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
- B. Size 1-1/2 inch to 4 inch:
1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

## 2.24 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
1. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
  2. Body: Bronze for NPS 2 inch and smaller. Cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating for NPS 2-1/2 inch and larger.
  3. End Connections: Threaded for NPS 2 inch and smaller. Flanged for NPS 2-1/2 inch and larger.
  4. Screen: Stainless steel with round perforations, unless otherwise noted.
  5. Perforation Size:
    - a. Strainers NPS 2 inch and Smaller: 0.062 inch (1.57 mm)
    - b. Strainers NPS 2-1/2 inch to NPS 4 inch: 0.125 inch (3.18 mm).
    - c. Strainers NPS 5 inch and Larger: 0.25 inch (6.35 mm)
  6. Drain: Factory-installed, hose-end drain valve.

## 2.25 BALANCING VALVES

- A. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Memory-Stop Balancing Valves:

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1. Standard: MSS SP-110 for two-piece copper alloy ball valve or MSS SP-80 for bronze straight pattern globe valves.
2. Pressure Rating: 125 psig minimum CWP.
3. Size: NPS 2 inch or smaller.
4. Body: Copper Alloy or Brass.
5. Ports: Standard or full test ports for differential pressure measurement.
6. Seats and Seals: Replaceable.
7. End Connections: Threaded.
8. Handle: Vinyl-covered steel or heavy duty plastic with memory-setting device.

## 2.26 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
  1. Standard: ASSE 1001.
  2. Size: NPS 1/4 to NPS 3 inch, as required to match connected piping.
  3. Body: Bronze.
  4. Inlet and Outlet Connections: Threaded.
  5. Finish: Chrome Plated.
- B. Pressure Vacuum Breakers:
  1. Standard: ASSE 1020.
  2. Operation: Continuous-pressure Applications.
  3. Accessories:
    - a. Valves: Ball Type, on inlet and outlet.

## 2.27 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
  1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
  2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
  3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
  4. Operating-Pressure Rating: 0.5 psig.
  5. End Fittings: Zinc-coated steel.
  6. Threaded Ends: Comply with ASME B1.20.1.
  7. Maximum Length: 72 inches
- B. Y-Pattern Strainers:
  1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
  2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
  3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  4. CWP Rating: 125 psig
- C. Basket Strainers:
  1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
  2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
  3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  4. CWP Rating: 125 psig
- D. T-Pattern Strainers:
  1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
  2. End Connections: Grooved ends.
  3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.

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4. CWP Rating: 750 psig
- E. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that excavations are to required grade, dry, and not over-excavated.

### **3.02 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.

### **3.03 TRENCHING FOR UNDERGROUND PIPING**

- A. Comply with requirements of Division 31.
- B. Comply with recommendations of available geotechnical report
- C. Installation and Construction: Trench excavation shall comply with AST D2321.
  1. Fill material shall be free of roots, rocks, debris, and organic materials. Fill material shall swell less than 3% when compacted.
  2. Sand bedding material shall be natural river or bank sand free of silt, clay, loam, friable or soluble materials, and organic materials. Graded in accordance with ANSI/ASTM C136.
  3. Trench backfill in layers.
  4. Compact bedding before placing pipe.
  5. Hand place fill material to six inches above top of pipe and compact fill without damaging piping.
  6. Remainder of fill may be placed in trench by gravity from height not exceeding 12-inches above trench.

### **3.04 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. Establish elevations of buried piping outside the building to ensure not less than 2 ft of cover.
- J. Install vent piping penetrating roofed areas to maintain integrity of roof assembly;
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- L. Provide support for utility meters in accordance with requirements of utility companies.
- M. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
- N. Excavate in accordance with Section 31 2316.
- O. Install bell and spigot pipe with bell end upstream.

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- P. Install valves with stems upright or horizontal, not inverted. Refer to Section 22 0523.
- Q. Install water piping to ASME B31.9.
- R. 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.
- S. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- T. Sleeve pipes passing through partitions, walls and floors.
- U. 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.
  - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- V. Pipe Hangers and Supports:
  - 1. Install in accordance with ASME B31.9.
  - 2. Support horizontal piping as indicated.
  - 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 inch 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. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
  - 10. Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 22 0548.
  - 11. Support cast iron drainage piping at every joint.
- W. 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.

### 3.05 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

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- D. Install globe valves for throttling, bypass, or manual flow control services.
- E. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.
- F. Provide spring loaded check valves on discharge of water pumps.
- G. Provide flow controls in water recirculating systems where indicated.

### **3.06 TOLERANCES**

- A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.
- B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

### **3.07 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM**

- A. Disinfect water distribution system in accordance with Division 31.
- B. Prior to starting work, verify system is complete, flushed and clean.
- C. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- F. Maintain disinfectant in system for 24 hours.
- G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

### **3.08 SERVICE CONNECTIONS**

- A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
  - 1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
  - 2. Provide 18 gage, 0.0478 inch galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

### **3.09 SCHEDULES**

- A. Pipe Hanger Spacing:
  - 1. Metal Piping:
    - a. Pipe Size: 1/2 inches to 1-1/4 inches:
      - 1) Maximum Hanger Spacing: 6.5 ft.
      - 2) Hanger Rod Diameter: 3/8 inches.
    - b. Pipe Size: 1-1/2 inches to 2 inches:
      - 1) Maximum Hanger Spacing: 10 ft.
      - 2) Hanger Rod Diameter: 3/8 inch.
    - c. Pipe Size: 2-1/2 inches to 3 inches:
      - 1) Maximum Hanger Spacing: 10 ft.
      - 2) Hanger Rod Diameter: 1/2 inch.
    - d. Pipe Size: 4 inches to 6 inches:

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- 1) Maximum Hanger Spacing: 10 ft.
    - 2) Hanger Rod Diameter: 5/8 inch.
  - e. Pipe Size: 8 inches to 12 inches:
    - 1) Maximum hanger spacing: 14 ft.
    - 2) Hanger Rod Diameter: 7/8 inch.
  - f. Pipe Size: 14 inches and Over:
    - 1) Maximum Hanger Spacing: 20 ft.
    - 2) Hanger Rod Diameter: 1 inch.
- 2. Plastic Piping:
  - a. All Sizes:
    - 1) Maximum Hanger Spacing: 6 ft.
    - 2) Hanger Rod Diameter: 3/8 inch.

**END OF SECTION 22 1005**

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## SECTION 22 1006 PLUMBING PIPING SPECIALTIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Hydrants.
- E. Backflow preventers.
- F. Double check valve assemblies.
- G. Water hammer arrestors.
- H. Mixing valves.

#### 1.02 RELATED REQUIREMENTS

- A. Section 22 1005 - Plumbing Piping.
- B. Section 22 4000 - Plumbing Fixtures.

#### 1.03 REFERENCE STANDARDS

- A. ASME A112.6.3 - Floor and Trench Drains.
- B. ASME A112.6.4 - Roof, Deck, and Balcony Drains.
- C. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers.
- D. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent.
- E. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies.
- F. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance.
- G. NSF 61 - Drinking Water System Components - Health Effects.
- H. NSF 372 - Drinking Water System Components - Lead Content.
- I. PDI-WH 201 - Water Hammer Arresters.
- J. NSF 61, "Drinking Water System Components."
- K. California Health & Safety Code 116875 for lead free content.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for 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.
- D. Operation Data: Indicate frequency of treatment required for interceptors.
- E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

#### 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.

### PART 2 PRODUCTS

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## 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: [www.jayrsmith.com/#sle](http://www.jayrsmith.com/#sle).
  - 2. MIFAB Mfg.: [www.mifab.com/#sle](http://www.mifab.com/#sle).
  - 3. Zurn Industries, LLC: [www.zurn.com/#sle](http://www.zurn.com/#sle).
- B. Roof Drains:
  - 1. Assembly: ASME A112.6.4.
  - 2. Body: Lacquered cast iron with sump.
  - 3. Strainer: Removable polyethylene dome with vandal proof screws.
  - 4. Accessories: Coordinate with roofing type.
    - a. Membrane flange and membrane clamp with integral gravel stop.
    - b. Adjustable under deck clamp.
    - c. Roof sump receiver.
    - d. Waterproofing flange.
    - e. Controlled flow weir.
    - f. Leveling frame.
    - g. Adjustable extension sleeve for roof insulation.
- C. Roof Overflow Drains:
  - 1. Lacquered cast iron body and clamp collar and bottom clamp ring; pipe extended to 2 inches above flood elevation.
- D. Downspout Nozzles:
  - 1. Bronze round with straight bottom section.
- E. Area Drains:
  - 1. Assembly: ASME A112.6.4.
  - 2. Body: Lacquered cast iron with sump.
  - 3. Strainer: Round nickel-bronze.
  - 4. Accessories: Membrane flange and membrane clamp with integral gravel stop, with adjustable under deck clamp.
- F. Floor Drain:
  - 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.
- G. Floor Sink:
  - 1. Lacquered cast iron body with dome strainer and seepage flange.
- H. Planter Drains:
  - 1. ASME A112.6.4; lacquered cast iron body with sump.
  - 2. Strainer: Removable polyethylene dome with stainless steel screen.
  - 3. Accessories: Membrane flange and membrane clamp with integral gravel stop.

## 2.03 CLEANOUTS

- A. Exposed Metal Cleanouts :
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
    - a. MIFAB, Inc.
    - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - c. Watts Drainage Products Inc.
    - d. Zurn Plumbing Products Group; Specification Drainage Operation

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2. Standard: ASME A112.3.1 for stainless steel for cleanout test tee.
  3. Size: Same as connected drainage piping
  4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
  5. Closure: Countersunk, brass plug.
  6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Metal Floor Cleanouts :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - b. Watts Drainage Products Inc.
    - c. Zurn Plumbing Products Group; Specification Drainage Operation.
  2. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron ferrule cleanout.
  3. Size: Same as connected branch.
  4. Type: Cast-iron soil pipe with cast-iron ferrule.
  5. Body or Ferrule:
  6. Clamping Device: Required.
  7. Outlet Connection: Inside calk.
  8. Closure: Brass plug with tapered threads.
  9. Adjustable Housing Material: Cast iron with threads.
  10. Frame and Cover Material and Finish: Stainless steel.
  11. Frame and Cover Shape: Round.
  12. Top Loading Classification: Heavy Duty.
  13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
  14. Standard: ASME A112.3.1.
  15. Size: Same as connected branch.
  16. Housing: Stainless steel.
  17. Closure: Stainless steel with seal.
  18. Riser: Stainless-steel drainage pipe fitting to cleanout.
- C. Cast-Iron Wall Cleanouts :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. MIFAB, Inc.
    - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - c. Watts Drainage Products Inc.
    - d. Zurn Plumbing Products Group; Specification Drainage Operation.
  2. Standard: ASME A112.36.2M. Include wall access.
  3. Size: Same as connected drainage piping.
  4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
  5. Closure: Countersunk, brass plug.
  6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
  7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
  8. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

## 2.04 ROOF FLASHING ASSEMBLIES

- A. Description: Manufactured assembly made of 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch- (1.6-mm-) thick, lead flashing collar and skirt extending at least 6 inches (150 mm) from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

## 2.05 VANDAL-PROOF VENT CAPS

- A. Description: Low-silhouette vandal-proof hooded vent cap for roof terminations of sanitary vent lines.

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1. Cast iron body.
2. Vandal-proof securing device.

B. Provide vandal-proof vent caps at all roof vent terminations.

## **2.06 THROUGH-PENETRATION FIRESTOP ASSEMBLIES**

- A. Through-Penetration Firestop Assemblies:
1. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
  2. Size: Same as connected soil, waste, or vent stack.
  3. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
  4. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
  5. Special Coating: Corrosion resistant on interior of fittings

## **2.07 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES**

- A. Floor-Drain, Trap-Seal Primer Fittings :
1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
  2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.
- B. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
  2. Body: Bronze or cast iron.
  3. Inlet: Opening in top of body.
  4. Outlet: Larger than inlet.
  5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- C. Sleeve Flashing Device :
1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches (51 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
  2. Size: As required for close fit to riser or stack piping.
- D. Stack Flashing Fittings :
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
  2. Size: Same as connected stack vent or vent stack.
- E. Vent Caps :
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
  2. Size: Same as connected stack vent or vent stack.

## **2.08 FLASHING MATERIALS**

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
  2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
  3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

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- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic

## **2.09 HOSE BIBBS**

- A. Manufacturers:
  - 1. Acorn Manufacturing Company: [www.acroneng.com/#sle](http://www.acroneng.com/#sle).
  - 2. Woodford Manufacturing Company: [www.woodfordmfg.com/#sle](http://www.woodfordmfg.com/#sle).
- B. Interior Hose Bibbs:
  - 1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with handwheel, integral vacuum breaker in compliance with ASSE 1011.

## **2.10 HYDRANTS**

- A. Manufacturers:
  - 1. Woodford Manufacturing Company: [www.woodfordmfg.com/#sle](http://www.woodfordmfg.com/#sle).
- B. Wall Hydrants:
  - 1. ASSE 1019; freeze resistant, self-draining type with chrome plated wall plate hose thread spout, handwheel, and integral vacuum breaker.

## **2.11 BACKFLOW PREVENTERS**

- A. Manufacturers:
  - 1. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
  - 2. Watts Regulator Company, a part of Watts Water Technologies: [www.wattsregulator.com/#sle](http://www.wattsregulator.com/#sle).
  - 3. Zurn Industries, LLC: [www.zurn.com/#sle](http://www.zurn.com/#sle).
- B. Reduced Pressure Backflow Preventers:
  - 1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

## **2.12 DOUBLE CHECK VALVE ASSEMBLIES**

- A. Manufacturers:
  - 1. Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
  - 2. Zurn Industries, LLC: [www.zurn.com/#sle](http://www.zurn.com/#sle).
- B. Double Check Valve Assemblies:
  - 1. ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

## **2.13 WATER HAMMER ARRESTORS**

- A. Manufacturers:
  - 1. MIFAB Manufacturing Company: [www.mifab.com/#sle](http://www.mifab.com/#sle).
- 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.

## **2.14 MIXING VALVES**

- A. Thermostatic Mixing Valves:
  - 1. Manufacturers:
    - a. Bradley:
    - b. Leonard Valve Company: [www.leonardvalve.com/#sle](http://www.leonardvalve.com/#sle).

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2. Valve: Chrome plated cast brass or glass-filled polysulfone body, stainless steel or copper alloy bellows or thermoplastic polymer cartridge, with integral temperature adjustment.
  3. Quality Assurance
    - a. Maximum Working Pressure: 125 psig (860 kPa), unless otherwise indicated.
    - b. Comply with NSF 61, "Drinking Water System Components."
    - c. Comply with California Health & Safety Code 116875 for lead free content.
  4. Accessories:
    - a. Check valve on inlets.
    - b. Volume control shut-off valve on outlet.
    - c. Strainer stop checks on inlets.
  5. Cabinet: 16 gage, 0.0598 inch prime coated steel, for recessed mounting with keyed lock.
- B. Pressure Balanced Mixing Valves:
1. Valve: Chrome plated cast brass body, stainless steel cylinder, integral temperature adjustment.
  2. Accessories:
    - a. Volume control shut-off valve on outlet.
    - b. Strainer stop checks on inlets.
  3. Cabinet: 16 gage, 0.0598 inch prime coated steel, for recessed mounting with keyed lock.

## **PART 3 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. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. 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.
- F. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories sinks and washing machine outlets .

**END OF SECTION 22 1006**

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## SECTION 22 1123 DOMESTIC WATER PRESSURE BOOSTING SYSTEMS

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

#### 1.02 SUMMARY

- A. Furnish and install a factory packaged and tested, variable-speed domestic water pressure boosting system including pumps, motors, controls, valves, interconnecting piping, wiring and accessories for a complete, NSF 61 and NSF 372 Certified system with UL508A Industrial Control Panel and UL QCZJ 3rd Party Package Label affixed. Manufacturer must have a Certification Number of the 3rd Party Laboratory/Agency that has completed the approval process and this must be available and currently dated upon request from the engineer.

#### 1.03 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
  - 1. Underwriters Laboratories Listings 508A Industrial Control Panels and QCZJ Packaged Pumping Systems (UL)
  - 2. 2019 Edition of the California Plumbing Code (CPC)
  - 3. 2019 Edition of the California Electric Code, Section 409.110 (CEC)
  - 4. National Electrical Manufacturers Association (NEMA)
  - 5. ANSI/NSF Standard 61-2018 - Drinking Water System Components - Health Effects
  - 6. ANSI/NSF Standard 372-2016 - Lead Free Plumbing Products

#### 1.04 QUALITY ASSURANCE

- A. All equipment under this section shall be furnished completely assembled and pre-tested at simulated project site conditions in a laboratory, by a single supplier and shall be products that the manufacturer regularly engages in the production of. The supplier shall have sole responsibility for proper functioning of the system and equipment supplied. Copies of simulated factory tests must be available at the request of the owner or engineer.
- B. The manufacturer of the domestic water pressure boosting system shall be responsible for compliance with all applicable codes and regulations, and be held accountable for the complete pump package. The manufacturer must maintain a closed-loop testing laboratory which is capable of pressurized suction and supply condition simulation. The test laboratory shall feature procedures detailing an unbroken chain of calibrations as required by NIST. Open atmospheric testing equipment which cannot mimic site installation conditions are not approved or acceptable.
- C. Manufacturer's Qualifications: Company specializing in manufacturing the products specified in this Section with a minimum five years documented experience. The packaged system manufacturer shall have local service available provided by a trained factory authorized representative. Manufacturer shall provide proof of a minimum \$2 Million liability insurance certificate for systems provided herein.

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- D. Assembly Qualifications: All disconnects, transformers, and control devices shall be installed to provide minimum wire bending clearances per C.E.C. All power wiring shall be a minimum THHN, stranded copper conductor with 90° C. insulation. Conductors shall be numbered and identified at all termination points. All wiring shall be installed in nylon wire ways and laced with nylon tie straps. All disconnects, transformers, controllers, control devices, selector switches, and indicator lights shall be provided with nameplates indicating their respective function and/or identification. A factory wiring schematic shall be provided inside the controller by the manufacturer. The entire assembly shall be wired and tested in accordance with the California Electrical Code (C.E.C. 2019, Section 409.110). All components shall be built to National Electrical Manufacturers Association (NEMA) standards and be Underwriters Laboratory (UL) 508A Industrial Control Panels. The entire package pumping system shall comply with Federal Regulations 29 CFR 1910.399 and certified through UL under category ULQCZJ or other accepted 3rd Party Compliance Laboratory.
- E. Installer's Qualifications: The system shall be installed by a firm having minimum ten years' experience regularly engaged in the installation of variable speed domestic booster pump systems.
- F. Certification shall be obtained by the manufacturer indicating that the function and performance characteristics of all products and materials have been determined by testing and ongoing surveillance by an approved third-party certification agency. Assertion of certification shall be in the form of identification in accordance with the requirements of the third-party certification agency and provided with submittal documentation to the engineer.

#### 1.05 SUBMITTALS

- A. Product Data:
  - 1. Provide system manufacturer's literature including general assembly, pump curves showing performance characteristics with pump and system with operating point indicated, NPSH required, controls, wiring diagrams, BAS connectivity and service connections as required.
  - 2. Code and Standards compliance.
  - 3. Third-Party Certifications.
- B. Record Documents:
  - 1. Provide full written description of manufacturer's warranty within the submittals.
  - 2. Shop Drawings: Indicate layout, general assembly, components, dimensions, weights, clearances, and installation recommendations.
  - 3. Manufacturer's Installation Instruction: Indicate support details, connection requirements, and include start-up instructions for pump system.
  - 4. Manufacturer's Certificate: Certify that pumps meet or exceed specified requirements at specified operating conditions. Submit summary and results of factory simulated-site tests performed.
  - 5. Provide estimated kWh performance for the system and yearly energy usage. Include reports with the submittal documents. Provide owner with load profile and calculations which clearly support energy savings payback ROI in the case of an energy performance requirement.
  - 6. Field Reports: Submit verification statement, signed by system manufacturer representative, of start-up, adjustment service and acceptance of installation. Indicate summary of field performance test, system pipe flushing and field acceptance tests performed.
- C. Operation and Maintenance Data:
  - 1. Operation Data: Include manufacturer's instructions, start-up data, and troubleshooting check lists for pumps, drivers, and controllers.

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2. Maintenance Data: Include manufacturer's literature, cleaning procedures, replacement parts lists, and repair data for pumps, drivers and controllers, preventive maintenance schedule, preventive maintenance recommendations and procedures. Identify place of purchase, location and contact numbers of service depot and technical support for each product installed.

#### **1.06 DELIVERY, STORAGE AND HANDLING**

- A. Accept pumps and components on Site in factory packing. Inspect for damage. Comply with manufacturers rigging and installation instructions.
- B. Protect pumps and components from physical damage including effects of weather, water, humidity, construction dust (concrete/drywall/gypsum), and construction debris.
- C. Provide temporary inlet and outlet caps, and maintain in place until installation.

#### **1.07 EXTRA MATERIALS**

- A. Refer to Section 01 78 46 for Maintenance Material Requirements.

#### **1.08 WARRANTY**

- A. All components furnished shall be warranted for a period of 5 years from documented date of shipment.

#### **1.09 MAINTENANCE SERVICE**

- A. Furnish service and maintenance of packaged system for one year from documented date of Substantial Completion.

### **PART 2 PRODUCTS**

#### **2.01 GENERAL**

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. All materials that may come in contact with the potable water delivered shall comply with ANSI/NSF Standard 61 and the "complete system" shall be certified as constructed. Individual component certification is not compliant.
- C. Pressure ratings of pumps, pipe, fittings, valves, gauges and all other water carrying appurtenances shall be suitable for the anticipated system pressures in which they are installed. Headers shall be constructed of 304 stainless steel at a minimum.
- D. The Contractor shall ascertain for himself the space and access available for the installation of a factory assembled pre-packaged and tested unit. All components of the system shall be compatible and be furnished by a single source manufacturer and all electrical services and interconnecting equipment wiring must be provided for a complete assembly with a single-source, fused power disconnect and water connections.
- E. The entire system shall be factory skid mounted on a minimum 304 stainless-steel structural square tube support frame, with in-shear molded rubber vibration isolators in compliance with standards as required in installation instructions published by pump manufacturer. Suction and Discharge Headers must be supported by pump skid frame to prevent piping strain on the pump casing and during system transport. No Exceptions.
- F. System must meet ANSI/ASHRAE/IES 90.1, Section 10.4.2, "Energy Standard for Buildings" and have proof of compliance utilizing either remote sensor option or software logic which adjusts set point according to flow rate.
- G. For isolation valve sizes 2" and smaller, valves shall be full port bronze ball valves with integral union, compliant ball and stem design. For isolation valve sizes 2.5" and larger, valves shall be epoxy coated ductile iron lever operated lug type butterfly valves with stainless steel disc and stainless steel shaft. Valves must be rated for maximum pressure service for the system and also comply with NSF 61 & 372 Drinking Water requirements.

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- H. Unions or flanges shall be provided for easy removal of pumps. System headers shall be sized for a velocity not exceeding 10 FPS at full flow and shall be terminated with a groove or flanged joint capable of accepting a groove coupling ANSI flange or groove flange furnished by Contractor.
- I. The packaged pumping system shall include all electrical wiring between components and shall be completely flow and pressure tested for actual site conditions at the factory prior to shipment.
- J. System shall be arranged such that single point connections are required for piping and electrical power supply. Multiple power connections are un-acceptable.
- K. Individual pumps, motors and check valves shall be serviceable with the booster system in operation utilizing isolation valves for each pump.
- L. Refer to schedules on Contract Drawings for required pump capacities and electrical characteristics.

## **2.02 ACCEPTABLE MANUFACTURERS**

- A. The following manufacturers are acceptable provided their products meet or exceed these Specifications and the Contract drawing schedules. Equal product compliance certification must include a signed letter from the manufacturers' owner or officer indicating products are in full compliance with all aspects of this specification as written:
  - 1. QuantumFlo
  - 2. Approved equal to these specifications with 10-day prior approval from the Engineer and Letter of Certification.

## **2.03 PUMPS AND MOTORS**

- A. System shall include vertical or horizontal mounted stainless steel, close-coupled, end suction centrifugal pumps with NPT threaded or ANSI flanged connections. Pump features to include stainless steel casing, back pull out design, top centerline discharge and hydraulically balanced stainless steel impeller with ceramic-carbon seal minimum. Pump shall be hydro-formed for maximum efficiency with stainless steel fitted construction and a replaceable shaft sleeve and mechanical seal.
- B. Motor shall be NEMA Premium Efficiency, Class F Insulated, Inverter duty, close-coupled type with a J, JM or TC type motor. Motors shall be TEFC enclosed and manufactured in accordance with NEMA standards for the voltage, frequency and phasing indicated on the pump schedule or plans.
- C. Motors shall be premium efficiency in accordance with DOE June 2016 requirements. Motors shall have ball bearings and operate at 40° ambient. Each motor shall be equipped with the manufacturer's nameplate and shall have a sufficient horsepower rating to operate the pump at any point on the pump's head-capacity curve without overloading the nameplate horsepower rating of the motor. The motor shall have a service factor of 1.15 for variations in voltage and frequency.
- D. Pumps and motors larger than 5 H.P. shall be mounted with rubber-in-shear isolators to reduce vibration and stress into the baseplate, machine and system piping as required.

## **2.04 VARIABLE FREQUENCY DRIVES**

- A. System shall feature variable frequency drives of the PWM design suitable for variable torque applications using any standard NEMA Design B squirrel cage induction motor. Variable frequency drives shall be sized for the maximum possible amp draw throughout the programmed sequence of pump operation.
- B. Drives shall be pulse width modulated, start into a rotating load, follow signal from logic section of control panel when in auto mode and be provided with the following features:
  - 1. Hand/off/auto switch and manual speed adjustment if auto system is inoperable.
  - 2. Auto Drive Shutdown for electrical fault.
  - 3. Automatic restart after power fails shutdown.

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4. Complete service diagnostics with fault history log up to 6 events.
- C. Keypad Operator Device including the following:
  1. Backlit LCD Display.
  2. Power On and Alarm/Fault Displays.
- D. Operational data displays include:
  1. Drive Speed [HZ]
  2. Motor Torque [%]
  3. Input Power [kW]
  4. Current [A]
  5. Elapsed Time [Hours]
  6. Motor Voltage [V]
- E. No electrical A-T-L (across the line) bypass shall be provided with any drive as the VFD is the only mode of pressure control.
- F. Drives shall be controlled via a Master/Slave control arrangement where the controller makes all adjustments via a high-speed interface which provides for greater PID resolution and PID auto-tuning. Exceptions to this requirement must be approved via pre-approval documentation with the engineer proving their energy-efficiency to the standard set forth.

## 2.05 PRESSURE SENSOR/TRANSMITTER

- A. Provide suction and discharge, Type 4X, stainless-steel pressure sensors/transmitters and internal separate pressure switch with integral event-logger, which provides a 4-20 mA signal output, compatible with the system controls, temperature and pressure requirements. Pressure sensor/transmitter shall have zero, span and damping devices. The transmitter shall be installed on the system suction and discharge headers and factory wired to the control circuitry. Sensor shall feature a high contrast LED readable from a 6-foot distance by maintenance personnel. When high-contrast LED transmitters are provided, other gauges or sensors are redundant and unnecessary.

## 2.06 SEQUENCE OF OPERATION

- A. The lead pump shall run only as necessary to maintain system pressure and will be controlled automatically by means of the pressure sensor/transmitter and programmable logic controller (PLC) designed to prevent short cycling and provide sensor-less flow detection. If the lead pump is unable to maintain system pressure the lag pump(s) will be called on as required by the sensor-less flow algorithm and will operate in parallel with the lead pump until no longer necessary and be sequenced off. When one pump can handle the system demand the controls will optimize energy consumption by eliminating the lag pump from sequence. When a low or no-flow condition is reached the system shall revert to the stand-by mode if no flow is present via an intelligent flow detection algorithm, which does not raise the set pressure to charge a tank to detect low flow. These systems DO NOT require a hydro-pneumatic tank installed and thereby does not raise the system pressure set point. (See 2.08) Note: Raising system pressure to charge a tank violates ANSI/ASHRAE/IES Standard 90.1 by raising the pressure in lieu of maintaining constant system pressure.
- B. An empty pipe condition is to be determined by an algorithm allowing for a slow ramp to set point to prevent system pressure shocks. The "pipe-fill" algorithm will also prevent VFD "wind-up" and pressure spikes associated with this condition.
- C. The system shall employ software to detect pipe break and stop system, initiate an alarm and log the event. In the event of a sensor failure, the system shall run one pump in a semi-automatic mode allowing the building to maintain a minimum pressure until the sensor can be repaired or replaced.

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- D. An auto-tuning PID algorithm shall continuously monitor system pressure and maintain steady-state system pressure as demand load changes rapidly and pump moves horizontally on its plumbing-performance curve. The PID algorithms shall incorporate intelligent algorithms to start the pumps at the point of creating pressure saving energy and reducing time to set pressure upon pump call.

## 2.07 CONTROL PANEL

- A. Logic Section - Provide, mount and wire on the skid a programmable logic controller in a NEMA 3R, splash-proof, forced-air ventilated enclosure to fully contain all VFD's and interface the signal from the pressure sensor to the VFD's and provide a stabilized response to speed up or slow down or add pumps to meet system requirements. The controller shall provide set point adjustment, timer adjustment, PID functions (as required) and both system and controller self-diagnostics via touch screen display. The HMI Screen shall feature an LED backlight, analog resistive, IP65/NEMA 4X, 2 GB eMMC Flash memory, rated 0-55 Degrees C with alarm logging and real-time, internal clock, Intel® Atom™ E620T 333 MHz clock speed. The touch screen display/human machine interface shall include a 7" TFT WVGA, 16.7 million color, 800x480 Pixels, resistive analog display with RS232/485 ports, Optional Ethernet (OPC-UA) and USB Ports for Upload/Download of system trend data.
- B. All user interface set points shall be easily accessible via a password protected display screen. The password shall be of the "rolling" type to prevent un-authorized access to factory settings. Normal system operation shall be auto-tuned to eliminate pressure hunting. Controller shall feature an (optional) USB Download connection which allows user to download trending analysis without the need for a formal BAS connection. All system data and settings shall be accessible from the display without the need to access the high-voltage controller internals. The software shall include clear alarm indications and user troubleshooting wizards to ascertain and correct all system alarms and conditions.
- C. Power Section – The internally touch-safe, high voltage controller with HMI shall be factory wired and mounted on a structural square-tube frame, stainless steel system skid. The panel shall be furnished with single-point power connection, fused main disconnect switch with a single door mounted and interlocked handle, each VFD shall be protected by a fused branch compact circuit protector. Multiple power source connections are un-acceptable. A 24-volt DC power supply shall be provided for logic, sensors and fan circuitry where necessary. Controller shall feature the following minimum additional components:
1. UL 1449 Type I Surge Arrestor with active over-voltage control via MOV's (metal oxide varistors). Passive surge or lightning arrestors are not acceptable.
  2. Low suction pressure shutdown circuit with auto reset and alarm logging.
  3. High system pressure shutdown circuit with auto reset and alarm logging.
  4. System key-logger which records all keypad entries stored in non-volatile memory. (downloadable)
  5. Audible alarm with silence push button and alarm log recognition of reset.
  6. Auto-alternate all pumps automatically on each stand-by cycle.
  7. 24 hour pump exerciser function which runs exercises pumps to maintain seal lubrication when the pump has not been started in the previous 24 hours.
  8. Auxiliary relay contacts for all alarm conditions or discreet data monitoring capability.
  9. Audible and visual indication of low storage tank level, with silence push button. (when optional suction break-tank is used)
  10. Elapsed time meters, system pressure, KW and other critical values, portable to system SCADA via discrete communication.
  11. Pipe Break Alarm with auto-shut down and time/date alarm logging of event.
  12. Table chart indicating system pressure and system KW with optional direct to USB Flash download for the most recent 1-week events, time and date stamped.
  13. The system shall not require external flow meters or KW monitoring. The system will not implement speed, thermal or time delay means to detect and shut down pumps on a no demand condition as this wastes energy and provides for unnecessary run times.

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14. System must feature ANSI/ASHRAE/IES Energy Standard 90.1 compliance via either a remote mounted pressure sensor or internal system logic which detects low flow and automatically adjusts set point according to piping losses at the condition with auto reset.
15. As per 2019 CEC, Section 409.110, control panel MUST have a listed minimum SCCR value, equal to or greater than the available fault current of the feeder circuit. A coordination study must be completed and furnished by the electrical designer or contractor to verify available fault current against the connected equipment.

## **2.08 HYDRO-PNEUMATIC TANK (NOT REQUIRED WITH SENSOR-LESS FLOW DETECTION)**

- A. If required for Low Flow Detection, provide a vertical hydro-pneumatic tank with a carbon steel shell and a replaceable FDA and NSF 61/372 approved heavy-duty bladder to separate the air and water. No water shall come in contact with the metal walls of the tank. Features shall include an air fill valve, pressure gauge connection and top system connection suitable for 100 percent drawdown.
- B. The tank shall be constructed in accordance with Section VIII of the ASME code and be National Board stamped and shall be rated for minimum 125 psig operating pressure and maximum operating temperature of 240 degrees F.
- C. Tank shall be factory finished in high quality epoxy or enamel paint.
- D. Systems which utilize sensor-less flow detection logic which does not raise system pressure to detect flow DO NOT REQUIRE the use of a tank and are allowed to be provided less this component.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Install the system level and in accordance with manufacturer's published recommendations.
- D. Locate equipment with allowance for manufacturer's recommended clearances around unit.
- E. Set entire unit on 4" high reinforced concrete equipment pad. Provide vibration isolators and bolt skid to pad. Structurally connect equipment pad to building slab to prevent movement.
- F. Pipe discharge from all relief valves, drains and individual pump thermal purge protection solenoid valves, indirectly to floor drain having adequate capacity to accept discharge.
- G. Provide, Type "L" copper full-size branch feed to the bladder tank (if required) with isolation valve from system distribution main as shown on the Contract Drawings.

### **3.02 FACTORY TESTING**

- A. The booster system shall be completely performance tested under project site simulated conditions and shall undergo a complete electric and hydraulic test from 0 to 100% design flow at the factory. The test shall be performed at the estimated site pressure conditions and pre-set to these conditions prior to shipment. Proof of simulated factory testing shall be provided to the engineer/owner. All control devices including transmitters and all safety features shall be factory calibrated and tested. Hydrostatic and/or electrical-only testing is NOT ACCEPTABLE as a compliant factory flow test.

### **3.03 VERIFICATION AND TESTING**

- A. Verify that the pumps and prime movers have been aligned according to manufacturers' recommendations.
- B. Test the system performance by verifying the operation of the pumps and system vs. the pump curves, alarms, controls, etc. Testing must include simulated site suction and discharge conditions at system flow.

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- C. Contractor shall inform Owner 48 hours in advance of verification and testing so that Owner's Construction and Physical Plant personnel may observe, performance verifications, verification of site conditions and testing of system performance, alarms and controls.

#### **3.04 INSTRUCTIONS AND START-UP**

- A. Provide for the service of a certified, factory-trained supervising agent from the pump package manufacturer to inspect the completed installation, start the system and acquaint the operators with the proper operation and maintenance of the equipment.

**END OF SECTION 22 1123**

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## SECTION 22 3000 PLUMBING EQUIPMENT

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Water Heaters:
  - 1. Commercial gas fired.
  - 2. Commercial electric.
- B. In-line circulator pumps.
- C. Cooling condensate removal pumps.

#### 1.02 RELATED REQUIREMENTS

- A. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- B. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

#### 1.03 REFERENCE STANDARDS

- A. ANSI Z21.10.1 - Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less.
- B. ANSI Z21.10.3 - Gas-Fired Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous.
- C. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels.
- D. NFPA 70 - National Electrical Code.
- E. UL 174 - Standard for Household Electric Storage Tank Water Heaters.
- F. UL 778 - Standard for Motor-Operated Water Pumps.

#### 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 3000 - Administrative Requirements, for submittals 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. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.

#### 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.

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- B. Certifications:
  - 1. Gas Water Heaters: Certified by CSA International to ANSI Z21.10.1, as applicable, in addition to requirements specified elsewhere.
  - 2. Electric Water Heaters: UL listed and labeled to UL 174.
  - 3. Water Tanks: ASME labeled to ASME BPVC-VIII-1.
  - 4. 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 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for domestic water heaters.

## **PART 2 PRODUCTS**

### **2.01 WATER HEATERS**

- A. Manufacturers:
  - 1. A.O. Smith Water Products Co: [www.hotwater.com/#sle](http://www.hotwater.com/#sle).
  - 2. Bock Water Heaters, Inc: [www.bockwaterheaters.com/#sle](http://www.bockwaterheaters.com/#sle).
  - 3. Bradford White: [www.bradfordwhite.com/#sle](http://www.bradfordwhite.com/#sle).
- B. Commercial Gas Fired:
  - 1. Type: Automatic, natural gas-fired, vertical storage.
  - 2. 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.
  - 3. Accessories:
    - a. Water Connections: Brass.
    - b. Dip Tube: Brass.
    - c. Drain valve.
    - d. Anode: Magnesium.
    - e. Temperature and Pressure Relief Valve: ASME labeled.
  - 4. Certified For The Following Applications:
    - a. Automatic circulating tank water heater.
    - b. For operation at 180 degrees F.
  - 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.
- C. Commercial Electric:
  - 1. Type: Factory-assembled and wired, electric, vertical storage.
  - 2. Accessories:
    - a. Water Connections: Brass.
    - b. Dip Tube: Brass.
    - c. Drain valve.
    - d. Anode: Magnesium.
    - e. Temperature and Pressure Relief Valve: ASME labeled.

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3. Tank: Welded steel ASME labeled pressure vessel; glass lining, mounted on steel channel base with lifting lugs, insulated with 2 inch glass fiber; enclosed with 16 gage, 0.0598 inch steel jacket; baked enamel finish.
4. Controls: Ventilated control cabinet, factory-wired with solid state progressive sequencing step controller, fuses, magnetic contactors, control transformer, pilot lights indicating main power and heating steps, control circuit toggle switch, electronic low-water (probe-type) cut-off, high temperature limit thermostat, flush-mounted temperature and pressure gauges.
5. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 W/sq in.

## **2.02 COMMERCIAL GAS FIRED WATER HEATERS**

- A. Commercial, Atmospheric, Gas-Fired, Storage, Domestic-Water Heaters:
  1. Refer to gas water heater schedule on Plumbing drawings for specification and additional information.

## **2.03 COMMERCIAL ELECTRIC WATER HEATERS**

- A. Commercial, Electric, Storage, Domestic-Water Heaters:
  1. Refer to electric water heater schedule on Plumbing drawings for specification and additional information.

## **2.04 IN-LINE CIRCULATOR PUMPS**

- A. Manufacturers:
  1. Bell & Gossett, a xylem brand: [www.bellgossett.com/#sle](http://www.bellgossett.com/#sle).
  2. Grundfos: [www.grundfos.com](http://www.grundfos.com)
  3. Substitutions: See Section 01 6000 - 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.

## **2.05 COOLING CONDENSATE REMOVAL PUMPS**

- A. Manufacturers:
  1. Franklin Electric Company: [www.franklin-electric.com/#sle](http://www.franklin-electric.com/#sle).
  2. Liberty Pumps Inc: [www.libertypumps.com/#sle](http://www.libertypumps.com/#sle).
- B. Construction: Commercial grade, nonferrous pump with stainless steel shaft, integral discharge check valve, integral float switch, safety switch, thermoplastic reservoir, motor assembly, and power cord with ground.
- C. Safety: UL 778.

## **2.06 ELECTRICAL WORK**

- A. Electrical characteristics to be as specified or indicated.
- B. 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.

## **PART 3 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. Pumps:

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1. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
2. 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.
3. Provide electrical interlocking from cooling condensate pump safety switch to associated HVAC unit(s) furnished under other Sections.

### **3.02 SCHEDULES**

- A. Refer to Drawings.

**END OF SECTION 22 3000**

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## SECTION 22 4000 PLUMBING FIXTURES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Water closets.
- B. Urinals.
- C. Lavatories.
- D. Sinks.
- E. Service sinks.
- F. Under-lavatory pipe supply covers.
- G. Showers.
- H. Eye and face wash fountains.
- I. Emergency showers.
- J. Hose Bibbs
- K. Trap Primers
- L. Water Hammer Arrestors
- M. Thermostatic Mixing Valves

#### 1.02 RELATED REQUIREMENTS

- A. Section 06 4100 - Architectural Wood Casework: Preparation of counters for sinks and lavatories.
- B. Section 07 9200 - Joint Sealants: Sealing joints between fixtures and walls and floors.
- C. Section 12 3600 - Countertops: Preparation of counters for sinks and lavatories.
- D. Section 22 1005 - Plumbing Piping.
- E. Section 22 1006 - Plumbing Piping Specialties.
- F. Section 22 3000 - Plumbing Equipment.

#### 1.03 REFERENCE STANDARDS

- A. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment.
- B. ASME A112.18.1 - Plumbing Supply Fittings.
- C. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures; The American Society of Mechanical Engineers; 2008 (R2011).
- D. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks.
- E. NSF 61 - Drinking Water System Components - Health Effects.
- F. NSF 372 - Drinking Water System Components - Lead Content.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- E. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

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## 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. Accessible Plumbing Fixtures:
  - 1. Accessible Plumbing Fixtures, plumbing fixtures intended for people with disabilities, shall comply with requirements contained in:
    - a. ICC A117.1, "Accessible and Usable Buildings and Facilities"
    - b. Public Law 90-480, "Architectural Barriers Act"
    - c. Public Law 101-336, "Americans with Disabilities Act"
  - 2. Accessible plumbing fixtures shall comply with requirements of CBC Division 6.
    - a. Heights and location of accessible plumbing fixtures shall comply with CBC Division 6 11B-602 through 11B-612.
    - b. Fixture controls for accessible plumbing fixtures shall comply with the following:
      - 1) CBC Section 11B-601.3 for drinking fountains
      - 2) CBC Section 11B-604.6 for water closets
      - 3) CBC Section 11B-604.9.5 for children's water closets
      - 4) CBC Section 11B-605.4 for urinals
      - 5) CBC Section 11B-606.4 for lavatories and sinks
      - 6) CBC Section 11B-607.5 for bath tubs
      - 7) CBC Section 11B-608.5 for showers
      - 8) CBC Section 11B-611.3 for washing machines and clothes dryers
  - 3. Heights and location of plumbing fixtures shall comply with DSA Checklist Figure 15-A.
  - 4. Accessible sinks shall be a maximum of 6-1/2" deep.
  - 5. Accessible sinks shall be mounted with the front of the counter or rim no higher and 34" above the finished floor.
  - 6. Water supply and drain pipes under lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under lavatories and sinks. Refer to CBC Section 11B-606.
- C. Plumbing Fixture Water Flow Rates:
  - 1. Comply with requirements in Public Law 102-486, "Energy Policy Act," regarding water flow and consumption rates for plumbing fixtures.
  - 2. Comply with requirements of California CCF Title 24, Part 11 "California Green Building Standards", Section 5.303 Indoor Water Use, regarding plumbing fixture maximum flow rates.
- D. NSF Standards: Comply with NSF 61, "Drinking Water System Components--Health Effects," and NSF 372 "Lead Content Compliance" for fixture materials that will be in contact with potable water. Provide pipe and fittings with NSF certification marks demonstrating compliance.
- E. Lead Content Restrictions: Domestic water piping, valves, and components shall conform to California AB 1953 Legislation as applicable for maximum allowable lead content.

## 1.06 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.

## 1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for electric water cooler.

## PART 2 PRODUCTS

### 2.01 GENERAL REQUIREMENTS

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- 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.
- B. Water Efficiency: EPA WaterSense label is required for all water closets, urinals, lavatory faucets, and showerheads.

## **2.02 REGULATORY REQUIREMENTS**

- A. Comply with applicable codes for installation of plumbing systems.
- B. Comply with UL (DIR) requirements.
- C. Perform work in accordance with local health department regulations.

## **2.03 GENERAL**

- A. Refer to schedules in Plumbing drawings for plumbing fixture specifications and additional information.

## **2.04 FLUSH VALVE WATER CLOSETS**

- A. Water Closets: Vitreous china, ASME A112.19.2, floor mounted, siphon jet flush action, china bolt caps. Flush Volume: 1.28 gallon per flush, maximum
  - 1. Manufacturers:
    - a. Kohler Company: [www.kohler.com](http://www.kohler.com).
- B. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
  - 1. Manufacturers:
    - a. Sloan Valve Company: [www.sloanvalve.com](http://www.sloanvalve.com).
- C. Seats:
  - 1. Manufacturers:
    - a. Bemis Manufacturing Company: [www.bemismfg.com](http://www.bemismfg.com).
    - b. Church Seat Company: [www.churchseats.com](http://www.churchseats.com).
    - c. Olsonite: [www.olsonite.com](http://www.olsonite.com).
- D. Water Closet Carriers:
  - 1. Manufacturers:
    - a. MIFAB Mfg.: [www.mifab.com](http://www.mifab.com).
    - b. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
  - 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.

## **2.05 WALL HUNG URINALS**

- A. Urinals: Vitreous china, ASME A112.19.2, wall hung with side shields and concealed carrier. Flush Volume: 0.125 gallon per flush, maximum.
  - 1. Manufacturers:
    - a. Kohler Company: [www.kohler.com](http://www.kohler.com).
- B. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
  - 1. Manufacturers:
    - a. Sloan Valve Company: [www.sloanvalve.com](http://www.sloanvalve.com).
- C. Wall Hung Urinal Carriers:
  - 1. Manufacturers:
    - a. MIFAB Mfg.: [www.mifab.com](http://www.mifab.com).
    - b. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
  - 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.

## **2.06 LAVATORIES AND SUPPLY FAUCETS**

- A. Manufacturers:

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1. Kohler Company: [www.kohler.com](http://www.kohler.com).
- B. Supply Faucet Manufacturers:
  1. Chicago Faucets : [www.chicagofaucets.com#sle](http://www.chicagofaucets.com#sle).

## **2.07 SINKS**

- A. Manufacturers:
  1. Just Mfg.: [www.justmfg.com](http://www.justmfg.com).
  2. Substitutions: See Section 01 6000 - Product Requirements.

## **2.08 UNDER-LAVATORY PIPE SUPPLY COVERS**

- A. Manufacturers:
  1. Mc Guire Mfg. Inc; Pro Wrap: [www.mcguiremfg.com/#sle](http://www.mcguiremfg.com/#sle).

## **2.09 BATHTUBS AND SHOWERS**

### **2.10 SHOWERS**

- A. Shower Manufacturers:
  1. Bradley Corporation: [www.bradleycorp.com/#sle](http://www.bradleycorp.com/#sle).
- B. Low-Flow Shower Head:
  1. ASME A112.18.1; chrome plated vandal-proof institutional head with integral wall bracket, built-in 1.5 gpm flow control.

### **2.11 DRINKING FOUNTAINS**

- A. Manufacturers:
  1. Elkay Manufacturing Company: [www.elkay.com](http://www.elkay.com).
  2. Haws Corporation: [www.hawsco.com](http://www.hawsco.com).

### **2.12 SERVICE SINKS**

- A. Service Sink Manufacturers:
  1. Kohler Commerical: [www.us.kohler.com/#sle](http://www.us.kohler.com/#sle).

### **2.13 EMERGENCY EYE AND FACE WASH**

- A. Manufacturers:
  1. Haws Corporation: [www.hawsco.com](http://www.hawsco.com).
  2. Bradley Corp.: [www.bradleycorp.com](http://www.bradleycorp.com)
- B. Emergency Wash: ANSI Z358.1; free standing, self-cleaning, non-clogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor, twin eye wash heads and face spray ring, stainless steel dust cover, copper alloy control valve and fittings.

### **2.14 EMERGENCY SHOWERS**

- A. Manufacturers:
  1. Haws Corporation: [www.hawsco.com](http://www.hawsco.com).
  2. Bradley Corp. [www.bradleycorp.com](http://www.bradleycorp.com)
- B. Emergency Shower: ANSI Z358.1; wall-mounted, self- cleaning, non-clogging 8 inch diameter stainless steel deluge shower head with elbow, one inch full flow valve with pull chain and 8 inch diameter ring, one inch interconnecting fittings.

### **2.15 HOSE BIBBS**

- A. Manufacturers:
  1. Acorn
  2. Woodford

### **2.16 TRAP PRIMERS**

- A. Manufacturers:
  1. MIFAB
  2. Precision Plumbing Products

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## **2.17 WATER HAMMER ARRESTORS**

- A. Manufacturers:
  - 1. MIFAB
  - 2. Precision Plumbing Products

## **2.18 THERMOSTATIC MIXING VALVES**

- A. Manufacturers:
  - 1. Bradley Corp.
  - 2. Leonard Valve Co.

# **PART 3 EXECUTION**

## **3.01 EXAMINATION**

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.
- C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

## **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.
- D. Install and secure fixtures in place with wall carriers or wall supports and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant. Color to match fixture.

## **3.04 INTERFACE WITH WORK OF OTHER SECTIONS**

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

## **3.05 ADJUSTING**

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

## **3.06 CLEANING**

- A. Clean plumbing fixtures and equipment.
- B. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

## **3.07 PROTECTION**

- A. Protect installed products from damage due to subsequent construction operations.
- B. Do not permit use of fixtures by construction personnel.
- C. Repair or replace damaged products before Date of Substantial Completion.

## **3.08 SCHEDULES**

- A. Refer to Drawings.

**END OF SECTION 22 4000**

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## SECTION 23 0500 COMMON WORK RESULTS FOR HVAC

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. This Section includes the following:
  - 1. Piping tube and fitting materials.
  - 2. Pipe joining materials.
  - 3. Transition fittings.
  - 4. Sleeves.
  - 5. Escutcheons.
  - 6. Equipment installation requirements common to equipment sections.
  - 7. Painting and finishing.
  - 8. Supports and anchorages.

#### 1.02 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CPVC: Chlorinated polyvinyl chloride plastic.
  - 3. PE: Polyethylene plastic.
  - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

#### 1.03 SUBMITTALS

- A. Product Data: For the following:
  - 1. All pipe materials & accessories applicable for scope of work under this section.
  - 2. Mechanical sleeve seals.
  - 3. Escutcheons.
- B. Welding certificates.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### 1.05 COORDINATION

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- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in **Division 8 Section 083100 "Access Doors and Frames."**

## **PART 2 - PRODUCTS**

### **2.01 PIPE, TUBE, AND FITTINGS MATERIALS**

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

### **2.02 PIPE JOINING MATERIALS**

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- C. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

### **2.03 TRANSITION FITTINGS**

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
  - 1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
  - 2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
  - 3. Aboveground Pressure Piping: Pipe fitting.
- B. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

### **2.04 ESCUTCHEONS**

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw. Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw. Polished chrome-plated and rough brass.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## **PART 3 - EXECUTION**

### **3.01 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

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- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
  - 1. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
  - 2. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
  - 3. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
  - 4. Install piping to permit valve servicing.
  - 5. Install piping at indicated slopes.
  - 6. Install piping free of sags and bends.
  - 7. Install fittings for changes in direction and branch connections.
  - 8. Install piping to allow application of insulation.
- C. Select system components with pressure rating equal to or greater than system operating pressure.

### 3.02 ESCUTCHEONS

- A. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

### 3.03 PENETRATIONS AND SLEEVES

- A. Permanent sleeves are not required for holes formed by removable PE sleeves.
- B. Install sleeves for pipes passing through gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    - b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
    - c. Seal space outside of sleeve fittings with grout.

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4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- C. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
- E. Verify final equipment locations for roughing-in.
- F. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.04 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

### 3.05 PIPING CONNECTIONS

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

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3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.06 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Grease fittings shall be installed in accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.07 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 9.
- B. Ductwork that will be painted, **provide galvanized/paintlock** from sheetmetal fabricator
- C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.08 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

**END OF SECTION 230130 23 0500**

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## SECTION 23 0517 SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Pipe sleeves.

#### 1.02 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

#### 1.03 SUBMITTALS

- A. **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. Pipe sleeves shall be submitted as sleeve drawings.

### PART 2 PRODUCTS

#### 2.01 PIPE SLEEVES

- A. **Vertical & Horizontal Piping:**
  - 1. Sleeve Length: 1 inch beyond **structural wall or floor assembly**.
  - 2. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- C. Provide sleeves when penetrating **shear** walls and roof. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required **with non-shrinking grout or approved caulking compound. Caulk/seal piping and ductwork passing through fire rated building with UL rated assemblies.**
  - 1. **Non Rated Openings:**
    - 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.
  - 2. **Rated Openings:** Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.
  - 3. **Exterior Openings:** Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- D. 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 23 0517**

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## SECTION 23 0529 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Metal Channel Strut Framing Systems
- B. Hanger Rods
- C. Pipe Supports
- D. Beam Clamps
- E. Riser Clamps
- F. Pipe Hangers
- G. Anchors & Fasteners
- H. Trapeze pipe hangers
- I. Equipment Supports

#### 1.02 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.

#### 1.03 SUBMITTALS

- A. **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. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.
- B. **SHOP DRAWINGS:** Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
  - 1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.
- C. **MFG INSTRUCTIONS:** Indicate manufacturer application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

#### 1.04 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.

#### 1.05 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

Hangers and Supports for HVAC Piping and Equipment	23 0529 - 1
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- 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 with a minimum safety factor of 2x. 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. **Outdoor or Wet Indoor Locations: Use stainless steel or hot dipped galvanized steel.**
      - 1) Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      - 2) 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. Manufacturers:
    - a. Cooper B-Line, a division of Eaton Corporation: [www.cooperindustries.com/#sle](http://www.cooperindustries.com/#sle).
    - b. Ferguson Enterprises Inc: [www.fnw.com/#sle](http://www.fnw.com/#sle).
    - c. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
    - d. Unistrut, a brand of Atkore International Inc: [www.unistrut.com/#sle](http://www.unistrut.com/#sle).
    - e. Tomarco
  2. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
  3. Comply with MFMA-4.
  4. Channel Material:
    - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
    - b. **Indoor Mechanical Room Locations: Use stainless steel 304 channel and rods.**
  5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
  6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
- C. **Hanger Rods:** Threaded zinc-plated steel unless otherwise indicated. **For rod sizes see drawing details**
- 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) insulation surrounded by a 360 degree, PVC jacketing.
  2. PVC Jacket:
    - a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.

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- b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
    - c. Thickness: 60 mil.
  - 3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
- 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.
- F. **Pipe Stanchions:** For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.
  - 1. Manufacturers:
    - a. Anvil International; H-Block: [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
    - b. Approved Equal.
  - 2. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
  - 3. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
- G. **Trapeze Pipe Hangers:** MSS SP-69, Type 59, shop or field fabricated pipe support assembly made from structural steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-Bolts
- H. **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.
- I. **Riser Clamps:**
  - 1. Provide copper plated clamps for copper tubing support.
- J. **Strut Clamps:** Two-piece pipe clamp.
- K. **Insulation Clamps:** Two bolt-type clamps designed for installation under insulation.
- L. **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.
- M. **Pipe Shields** for Insulated Piping:
  - 1. General Construction and Requirements:
    - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
    - b. Shields Material: UV-resistant polypropylene with glass fill.
    - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
    - d. Minimum Service Temperature: Minus 40 degrees F.
    - e. Maximum Service Temperature: 178 degrees F.
    - f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- N. **Anchors and Fasteners:**
  - 1. Manufacturers - Mechanical Anchors:
    - a. Hilti, Inc: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
    - b. ITW Red Head, a division of Illinois Tool Works, Inc: [www.itwredhead.com/#sle](http://www.itwredhead.com/#sle).
    - c. Powers Fasteners, Inc: [www.powers.com/#sle](http://www.powers.com/#sle).

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- d. Simpson Strong-Tie Company Inc: [www.strongtie.com/#sle](http://www.strongtie.com/#sle).
- e. Approved Equal.
- 2. Manufacturers - Powder-Actuated Fastening Systems:
  - a. Hilti, Inc: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
  - b. ITW Ramset, a division of Illinois Tool Works, Inc: [www.ramset.com/#sle](http://www.ramset.com/#sle).
  - c. Powers Fasteners, Inc: [www.powers.com/#sle](http://www.powers.com/#sle).
  - d. Simpson Strong-Tie Company Inc: [www.strongtie.com/#sle](http://www.strongtie.com/#sle).
  - e. Approved Equal.
- 3. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
- 4. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
- 5. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
- 6. Hollow Masonry: Use toggle bolts.
- 7. Hollow Stud Walls: Use toggle bolts.
- 8. Steel: Use beam clamps, machine bolts, or welded threaded studs.
- 9. Sheet Metal: Use sheet metal screws.
- 10. Wood: Use wood screws.
- 11. Plastic and lead anchors are not permitted.
- 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.

### **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. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- H. Equipment Support and Attachment:
  - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.

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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.
- I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
  - J. Secure fasteners according to manufacturer's recommended torque settings.
  - K. 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 23 0529**

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## SECTION 23 0548 VIBRATION AND SEISMIC CONTROLS FOR HVAC

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Seismic control requirements.

#### 1.02 DEFINITIONS

- A. HVAC Component: Where referenced in this section in regards to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g. ductwork, piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

#### 1.03 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings.
- C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications.
- D. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172.
- E. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment 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. Seismic Controls:
    - a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
    - b. Coordinate the work with other trades to accommodate relative positioning of essential and non-essential components in consideration of seismic interaction.

#### 1.05 SUBMITTALS

- A. **SHOP DRAWINGS - Vibration Isolation & Seismic Controls Systems:**
  - 1. Provide table schedule of vibration isolator type & seismic restraint system with equipment tag, location and loads.
  - 2. Include auxiliary motor slide bases and rails, base weights, inertia bases, concrete weights, equipment static loads, support points, vibration isolators, and detailed layout of isolator location and orientation with static and dynamic load on each isolator.
  - 3. **Vibration Isolation Shops -**
    - a. Vibration Isolation Systems: Include scaled fabrication plans, installation details & sections indicating proposed arrangement of vibration isolators and static deflections.
    - b. Vibration-Isolated Equipment Support Bases:
      - 1) Include base weights, including concrete fill where applicable; indicate equipment mounting provisions, attachments to isolators and supported equipment.

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- 2) Vibration Isolation Curbs provide OPM Certification by manufacturer, and associated calculations
4. **Seismic Restraint Shops -**
  - a. Provide all calculations from prescriptive design tables that indicate compliance with the applicable building code for seismic controls along with load and capacity assumptions.
  - b. Include the seal of the Professional Structural Engineer registered in the State of California in which the Project is located, on drawings and calculations which at a minimum include the following:
    - 1) Seismic Restraint Details: Detailed drawings of seismic restraints and snubbers including anchorage details that indicate quantity, diameter, and depth of penetration, edge distance, and spacing of anchors.
5. Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.

## 1.06 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 20 years of documented experience.

## 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.
- D. Equipment Isolation: As indicated on drawings.

### 2.02 MANUFACTURERS

- A. **Kinetics Noise Control, Inc:** [www.kineticsnoise.com/#sle](http://www.kineticsnoise.com/#sle).
- B. **Mason Industries:** [www.mason-ind.com/#sle](http://www.mason-ind.com/#sle).
- C. **Tomarco ISAT:** <http://www.tomarco.com/isat.html>
- D. **MW Sause Vibrex:** <https://www.vibrex.net/>
- E. [Approved Equal]

### 2.03 PERFORMANCE REQUIREMENTS

- A. General:
  1. All vibration isolators, base frames and inertia bases to conform to all uniform deflection and stability requirements under all operating loads.
  2. Steel springs to function without undue stress or overloading.
  3. Steel springs to operate in the linear portion of the load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
  4. Lateral to vertical stiffness ratio to not exceed 0.08 with spring deflection at minimum 75 percent of specified deflection.
  5. All equipment mounted on vibration isolated bases to have minimum operating clearance of 2 inches between the base and floor or support beneath unless noted otherwise.

### 2.04 SEISMIC RESTRAINTS FOR SUSPENDED COMPONENTS AND EQUIPMENT

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- A. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- B. Cable Restraints:
  - 1. Comply with ASCE 19.
  - 2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
  - 3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
  - 4. Use protective thimbles for cable loops where potential for cable damage exists.
- C. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.
- D. Comply with:
  - 1. SMACNA (SRM).
- E. Cable Restraints:
  - 1. Wire Rope: Steel wire strand cables sized to resist seismic loads in all lateral directions.
  - 2. Protective Thimbles: Eliminates potential for dynamic cable wear and strand breakage.
  - 3. Size: Based on the lesser of cable capacity or anchor load taking into account bracket geometry.
  - 4. Connections:
    - a. Use overlapping wire rope U clips, cable clamping bolts, swaged sleeves or seismically rated tool-less wedge insert lock connectors.
    - b. Internally brace clevis hanger bracket cross bolt to prevent deformation.
  - 5. Vertical Suspension Rods: Attach required bracing of sufficient strength to prevent rod buckling from vertical compression forces utilizing series of attachment clips.
- F. Rigid Restraints:
  - 1. Structural Element: Sized to resist seismic loads in all lateral directions and carry both compressive and tensile loading.
  - 2. Size: Based on the lesser of cable capacity or anchor load taking into account bracket geometry.
  - 3. Connections: Internally brace clevis hanger bracket cross bolt to prevent deformation.
  - 4. Static Support System: Anchorage capable of carrying additional tension loads generated by the vertical component of the rigid brace compression which is additive to any static load requirements on the system.
  - 5. Vertical Suspension Rods: Attached required bracing of sufficient strength to prevent rod buckling from vertical compression forces utilizing series of attachment clips.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION - GENERAL**

- A. Install in accordance with manufacturer's instructions.
- B. Bases:
  - 1. Set steel & concrete inertia bases for 2 inches clearance between housekeeping pad and base.
  - 2. Adjust equipment level.
- C. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- D. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- E. Provide pairs of horizontal limit springs on fans with more than 6.0 inches WC static pressure, and on hanger supported, horizontally mounted axial fans.
- F. Support piping connections to equipment mounted on isolators using isolators or resilient hangers for scheduled distance.

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1. Up to 4 Inches Pipe Size: First three points of support.
2. 5 to 8 Inches Pipe Size: First four points of support.
3. 10 inches Pipe Size and Over: First six points of support.
4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

### 3.02 INSTALLATION - SEISMIC

- A. Comply with:
  1. SMACNA (SRM).
- B. Floor and Base-Mounted Equipment, Vibration Isolated Equipment and associated Vibration and Seismic Controls for Connections:
  1. Install equipment anchorage items designed to resist seismic design force in any direction.
  2. Install vibration and seismic controls designed to include base and isolator requirements.
  3. Provide flexible connections between equipment and interconnected piping.
  4. Provide isolators and restraints designed for amplified code forces per ASCE 7 and with demonstrated ability to resist required forces including gravity, operational and seismic forces.
  5. Where equipment is not designed to be point loaded, provide base capable of transferring gravity and seismic demands from equipment to isolator base plate anchorage.
  6. Where concrete floor thickness is less than required for expansion anchor installation, install through bolt in lieu of expansion anchor.
  7. Where timber/wood floor or other substrate is inadequate for installation of lag bolts, screws or other mechanical fasteners, install supplemental framing or blocking to transfer loads to structural elements.
- C. Suspended Mechanical Equipment:
  1. Provide supports and bracing to resist seismic design force in any direction.
  2. Provide flexible connections between equipment and interconnected piping.
  3. Brace equipment hung from spring mounts using cable or other bracing that will not transmit vibration to the structure.
  4. Use of proprietary restraint systems with a certificate of compliance, verified and listed by an accredited inspection body is acceptable (pending shop drawing approval), as an alternative to project specific seismic bracing design.
- D. Wall mounted Mechanical Equipment:
  1. Provide support and bracing to resist seismic design force in any direction.
  2. Install backing plates or blocking as required to deliver load to primary wall framing members.
  3. Anchoring to gypsum wallboard, plaster or other wall finish that has not been engineered to resist imposed loads is not permitted.
- E. Piping:
  1. Provide seismic bracing in accordance ASCE 7.
  2. Provide supports, braces, and anchors to resist gravity and seismic design forces.
  3. Provide flexible connections between floor mounted equipment and suspended piping; between unbraced piping and restrained suspended items; as required for thermal movement; at building separations and seismic joints; and wherever relative differential movements could damage pipe in an earthquake.
  4. Brace resiliently supported pipe with cable bracing or alternate means designed to prevent transmission of vibrations and noise to the structure.
  5. **Brace spacing shall be per drawing detail** in length with two transverse and one longitudinal bracing locations.
  6. Pipes and Connections Constructed of Ductile Materials (copper, ductile iron, steel or aluminum and brazed, welded or screwed connections):

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7. Pipes and Connections Constructed of Non Ductile Materials (cast iron, no-hub, plastic or non-UL listed grooved coupling pipe):
  8. Provide lateral restraint for risers at not more than 30 feet on center or as required for horizontal runs, whichever is less.
  9. Piping Explicitly Exempt from Seismic Bracing Requirements:
    - a. Provide flexible connections between piping and connected equipment, including in-line devices such as VAV boxes and reheat coils.
    - b. Install piping consistent with ASCE 7, such that swinging of the pipes will not cause damaging impact with adjacent components, finishes, or structural framing while maintaining clear horizontal distance of 67 percent of the hanger length between subject components.
    - c. Provide swing restraints as required to control potential impact due to limited space between subject components.
  10. Use of proprietary restraint systems with a certificate of compliance, verified and listed by an accredited inspection body is acceptable (pending shop drawing approval), as an alternative to project specific seismic bracing design.
  11. Re-use of Existing Hangers:
    - a. Re-using existing hangers at locations of seismic bracing are to be judged on a case-by-case basis by the registered project design professional.
    - b. Unless otherwise shown on drawings, it is assumed all hangers supporting new piping, located at a seismic brace, will be new.
- F. Ductwork:
1. **Provide seismic bracing for ducts with cross sectional area greater than 6 SQ FT in cross sectional area** (independent of duct contents).
  2. Provide seismic bracing for all ducts containing hazardous materials.
  3. Provide supports, braces, and anchors to resist gravity and seismic design forces.
  4. Install ducts and duct risers designed to accommodate interstory drift.
  5. Independently support in-line devices weighing **more than 20 lbs / LF**.
  6. Independently support and brace all in-line devices weighing more than 75 pounds.
  7. Provide unbraced piping attached to braced in-line equipment with adequate flexibility to accommodate differential displacements.
  8. Positively attach dampers, louvers, diffusers and similar appurtenances to ductwork with mechanical fasteners.
  9. Install duct supports designed to resist not less than 150 percent of the duct weight.
  10. The use of power driven fasteners is prohibited in the hanging of ducts weighing over 10 pounds per lineal foot for seismic design categories D, E, and F.
  11. Use of proprietary restraint systems with a certificate of compliance, verified and listed by an IAS AC172 accredited inspection body or otherwise accepted by Authority Having Jurisdiction is acceptable (pending shop drawing approval), as an alternative to project specific seismic bracing design.

### 3.03 FIELD QUALITY CONTROL

- A. Vibration Isolation Systems:
  1. Verify isolator static deflections.
  2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- B. Inspect isolated equipment after installation and submit report. Include static deflections.

### 3.04 SCHEDULE

- A. Equipment Isolation Schedule.
  1. Refer to Drawings.

**END OF SECTION 23 0548**

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## SECTION 23 0553 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Adhesive-backed duct markers.
- D. Pipe markers.
- E. Ceiling tacks.
- F. Duct Labels.

#### 1.02 SUBMITTALS

- A. **SCHEDULE:** Submit **FULL IDENTIFICATION TABLE/SCHEDULE** to include:
  - 1. Nameplate Tag Format
  - 2. Pipe Valve Tag Format
  - 3. Duct Label Tag Format
  - 4. System Type
  - 5. Symbols
  - 6. Letter Sizes
  - 7. Color Coding.
- B. **PRODUCT DATA:** Provide manufacturers catalog literature for each product required
- C. **SAMPLES:** Provide examples/samples for owner review of the following:
  - 1. Equipment Nameplates
- D. Project Record Documents: Record actual locations of tagged valves.

### PART 2 PRODUCTS

#### 2.01 IDENTIFICATION APPLICATIONS

- A. Air Handling Units / Rooftop Units: Nameplates.
- B. Control Panels: Nameplates.
- C. Ductwork: Duct Labels.
- D. Major Control Components: Nameplates.
- E. Piping: Pipe markers.
- F. Small-sized Equipment - Fans, Split Systems, VRF Systems: Nameplates
- G. Thermostats: Tags
- H. Valves: Tags and ceiling tacks where located above lay-in ceiling.

#### 2.02 NAMEPLATES

- A. **Manufacturers:**
  - 1. **Craftmark Pipe Markers**
  - 2. **Seton Identification Products / Tricor Direct / Brady Corporation**
  - 3. **Kolbi Pipe Marker Company**
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

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- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F
- E. Multi-layered metalized polyester with permanent adhesive for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
  - 1. Letter Color: Black.
  - 2. Letter Height: 1/4 inch, for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.minimum.
  - 3. Background Color: WHITE.
  - 4. Plastic: Coforms to ASTM D709.
  - 5. Fastners: Stainless-steel rivets or self tapping screws
  - 6. Adhesive: Contact type permanent adhesive, compatible with label and with substrate

## 2.03 TAGS

- A. **Manufacturers:**
  - 1. **Craftmark Pipe Markers**
  - 2. **Seton Identification Products / Tricor Direct / Brady Corporation**
  - 3. **Kolbi Pipe Marker Company**
- 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. Content: Minimum information indicating unique valve or instrument tag
- D. Metal Tags: Stainless Steel with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

## 2.04 ADHESIVE-BACKED DUCT LABELS

- A. **Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch; printed with UV and chemical resistant inks.**
- B. Style: Individual Label.
- C. Color: Yellow/Black.

## 2.05 PIPE MARKERS

- A. Refrigerant Piping
  - 1. Background Color: Yellow
  - 2. Letter Color: Black
- B. Content: Minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Size:
  - 1. Up to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field,
  - 2. Over 2 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, **1-1/2 inch** high letters.
- D. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering.
- E. Color code as follows:
  - 1. HVAC Equipment: Yellow.
  - 2. Fire Dampers and Smoke Dampers: Red.
  - 3. Heating/Cooling Valves: Blue.

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## **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 ductwork with duct labels. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
  - 1. Blue: For cold-air supply ducts
  - 2. Green: For exhaust, outside, relief, return, and mixed air ducts
  - 3. ASME A13.1 Colors and Designs
  - 4. Maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling systems.
- E. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

**END OF SECTION 23 0553**

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## SECTION 23 0593 TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of AIR SIDE systems.
- B. Testing, adjustment, and balancing of WATER systems.
- C. Measurement of final operating condition of HVAC systems.
- D. Commissioning activities.

#### 1.02 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition.
- B. AABC MN-1 - AABC National Standards for Total System Balance.
- C. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.
- D. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems.
- E. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing.

#### 1.03 SUBMITTALS

- A. 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 the 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. **DUCTWORK LEAKAGE TESTING:**
      - 1) Ductwork requiring testing, representative sections shall total no less than 10 percent of the total existing and new duct area shall be tested. Testing shall be witnessed by commissioning agent, and if desired by owner.
      - 2) Where the tested 10 percent fail to comply with the requirements of 2019 CMC 603.10.1, then 40 percent of the total installed duct area shall be tested.
      - 3) Where the tested 40 percent fail to comply with the requirements of this section, then 100 percent of the total installed duct area shall be tested.
      - 4) Sections shall be selected by the building owner or designated representative of the building owner. Positive pressure leakage testing shall be permitted for negative pressure ductwork.
    - b. **WATER PIPING PRESSURE TESTING:**
      - 1) System piping and components shall be tested in accordance to 2019 CMC 1205.2 with a pressure of not less than one and one-half times the operating pressure but not less than 100 psi (689 kPa). **Testing shall be witnessed by commissioning agent, and if desired by owner.**
      - 2) Piping shall be tested with water or air except that plastic pipe shall NOT be tested with air.
      - 3) Test pressures shall be held for a period of not less than 30 minutes with no perceptible drop in pressure.
    - c. **Refrigeration Piping Testing:** See 232300 Refrigeration Piping Specification
    - d. 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.

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- e. 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.
  - f. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
  - g. Final test report forms to be used.
  - 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.
  - 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. Procedures for formal deficiency reports, including scope, frequency and distribution.
- B. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- 1. Revise TAB plan to reflect actual procedures and submit as part of final report.
  - 2. 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.
  - 3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
  - 4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
  - 5. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance **with the following**:
  - 1. **AABC (NSTSB), AABC National Standards** for Total System Balance.
  - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
  - 3. 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 **TEN** years documented experience.
  - 3. **Certified by one of the following:**
    - a. **AABC, Associated Air Balance Council:** [www.aabc.com/#sle](http://www.aabc.com/#sle); upon completion submit AABC National Performance Guaranty.
    - b. **NEBB, National Environmental Balancing Bureau:** [www.nebb.org/#sle](http://www.nebb.org/#sle).
    - c. **TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute:** [www.tabbcertified.org/#sle](http://www.tabbcertified.org/#sle).

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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.

### **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.

### **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. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. 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.

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- 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.

**END OF SECTION 23 0593**

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## SECTION 23 0713 DUCT INSULATION

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. INDOOR - Duct insulation
- B. OUTDOOR - JACKETS
- C. INDOOR & OUTDOOR - Duct liner
- D. Insulation jackets.

#### 1.02 SUBMITTALS

- A. **PRODUCT OVERVIEW:** Provide insulation table/schedule format for all system types matching drawing M0.20 insulation table/schedule & 2019 CEC T24 Requirements
- B. **PRODUCT DATA:** Provide proposed manufacturer insulation cut sheets clearly identifying thicknesses, R Values, material and thermal characteristics.

#### 1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with with a **minimum of [ten] years** of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with a **minimum of [ten] years** of documented experience.

#### 1.04 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 on an elevated skid from floor.**

### 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, UL 723, ASTM E84, or UL 723.

#### 2.02 INDOOR GLASS FIBER - FLEXIBLE

- A. Manufacturer:
  - 1. Knauf Insulation; Duct Wrap: [www.knaufinsulation.com](http://www.knaufinsulation.com)
  - 2. Johns Manville; Microlite: [www.jm.com](http://www.jm.com)
  - 3. Owens Corning Corporation; All Service Duct Wrap: [www.ocbuildingspec.com](http://www.ocbuildingspec.com)
  - 4. Approved Equal.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
  - 1. **Density: 0.75 lbs/cu. ft. (nominal), R-4.2**
  - 2. Maximum Service Temperature: 250 degrees F.
  - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
  - 4. **Thickness: Indoor - 1.5 inches per drawing schedule**
- C. Vapor Barrier Jacket:
  - 1. Kraft paper with glass fiber yarn and bonded to aluminized film ('FSK') or White kraft paper with glass fiber yarn ('PSK').
  - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
  - 3. Secure with pressure sensitive tape.

#### 2.03 OUTDOOR - JACKETS

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- A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
- B. Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, 50 lb/square.
- C. Aluminum Jacket: ASTM B209 (ASTM B209M).
  - 1. Thickness: 0.020 inch sheet.
  - 2. Finish: Embossed.
  - 3. Joining: Longitudinal slip joints and 2 inch laps.
  - 4. **Fittings: 0.024 inch thick** die shaped fitting covers with factory attached protective liner.
  - 5. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

## 2.04 INDOOR & OUTDOOR - DUCT LINER

- A. Duct liner shall be per drawing insulation schedule, and as indicated per plans.
- B. Manufacturers:
  - 1. Armacell LLC: [www.armacell.us/#sle](http://www.armacell.us/#sle).
  - 2. Ductmate Industries, Inc. (PolyArmor polyester duct liner): <https://ductmate.com/>
  - 3. Knauf Insulation: [www.knaufinsulation.com](http://www.knaufinsulation.com).
  - 4. Johns Manville: [www.jm.com/#sle](http://www.jm.com/#sle).
- C. **Polyester: Hypoallergenic polyester material webbed into a thermal blanket, which is then bonded with a FSK facing to resist damage during system installation and operation.**
- D. Insulation: Non-corrosive, incombustible polyester fiber complying with ASTM C1071 and ASTM E84; webbed into a thermal blanket which is then bonded with a FSK Facing.
  - 1. Fungal Resistance: No growth when tested according to ASTM G21.
  - 2. Thermal Resistance at 75 degrees F per ASTM C518:
    - a. 1-inch Thickness: R-4.2
    - b. 1-1/2 inch Thickness: R-6
    - c. 2-inch Thickness: R-8
  - 3. Service Temperature: Up to 250 degrees F.
  - 4. Rated Velocity on Coated Air Side for Air Erosion: 2000 fpm, minimum.
  - 5. Minimum Noise Reduction Coefficients:
    - a. 1 inch Thickness: 0.65.
    - b. 1-1/2 inches Thickness: 0.65.
    - c. 2 inch Thickness: 0.65.
- E. Adhesive: Waterproof, fire-retardant type, ASTM C916.
- F. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that ducts have been tested before 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. Provide insulation with vapor barrier jackets.
  - 2. Finish with tape and vapor barrier jacket.
  - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

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- D. Insulated ducts conveying air above ambient temperature:
  - 1. Provide with or without standard vapor barrier jacket.
  - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with aluminum jacket.
- F. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with weather resistant aluminum jacket.
- G. External Duct Insulation Application:
  - 1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
  - 2. Secure insulation without vapor barrier with staples, tape, or wires.
  - 3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
  - 4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
  - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- H. Duct and Plenum Liner Application:
  - 1. Adhere insulation with adhesive for 90 percent coverage.
  - 2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
  - 3. Seal and smooth joints. Seal and coat transverse joints.
  - 4. Seal liner surface penetrations with adhesive.
  - 5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

### 3.03 SCHEDULES

- A. Refer to Drawings for Duct Insulation Schedule.

**END OF SECTION 23 0713**

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## SECTION 23 0719 HVAC PIPING INSULATIONS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Jackets and accessories.

#### 1.02 SUBMITTALS

- A. **PRODUCT OVERVIEW:** Provide insulation table/schedule format for all system types matching drawing M0.20 insulation table/schedule & 2019 CEC T24 Table 120.3-A Pipe Insulation Thickness Requirements
- B. **PRODUCT DATA:** Provide proposed manufacturer insulation cut sheets clearly identifying thicknesses, R Values, material and thermal characteristics.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

#### 1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with a **minimum of [ten] years** of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with a **minimum of [ten] years** of documented experience.

#### 1.04 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 on an elevated skid from floor.

### 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, UL 723, ASTM E84, or UL 723.

#### 2.02 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
  - 1. Aeroflex USA, Inc; Aerocel: [www.aeroflexusa.com/#sle](http://www.aeroflexusa.com/#sle).
  - 2. Armacell LLC; AP Armaflex: [www.armacell.us/#sle](http://www.armacell.us/#sle).
  - 3. RBX Corporation; Insul-Sheet 1800 and Insul-Tub 180.
  - 4. **Approved Equal**
- 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: 220 degrees F.
  - 3. Connection: Waterproof vapor barrier adhesive.

#### 2.03 JACKETS

- A. **PVC Plastic: For Indoor Mechanical Rooms Only.**
  - 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 D1784 & ASTM E96/E96M.
    - d. **Thickness: 30 mils.**

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- e. Connections: Brush on welding adhesive.
- 2. Covering Adhesive Mastic: Compatible with insulation.
- B. **Aluminum Jacket: For Outdoor Applications Only**
  - 1. **Material: ASTM B209 (ASTM B209M) formed aluminum sheet, stucco embossed.**
  - 2. **Thickness: 0.024 inch thick sheet.**
  - 3. Finish: Embossed.
  - 4. Joining: Longitudinal slip joints and 2 inch laps.
  - 5. **Fittings: 0.024 inch** thick die shaped fitting covers with factory attached protective liner.
  - 6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

## PART 3 EXECUTION

### 3.01 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; insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- F. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- G. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.
- H. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.
- I. **Exterior Applications: Provide vapor barrier jacket.** Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

### 3.02 SCHEDULE

- A. Refer to Drawings for HVAC Piping Insulation Schedule
- B. **Refrigerant Systems:**
  - 1. Insulate all refrigerant system suction, liquid, hot-gas and discharge piping per insulation schedule, code requirements, and equipment manufacturer recommendations.
  - 2. Flexible Elastomeric Cellular Insulation, **minimum 2.0 inch thick.**

**END OF SECTION 23 0719**

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## SECTION 23 0923 DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

- A. **Delta BACnet Energy Management System (EMS) as specified herein to tie into and match the Davis Joint Unified School District (JUSD) current Energy Management System Standard.** The operator's workstation, all building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135-2008, BACnet. In other words, all workstations and controllers, including unitary controllers, shall be native BACnet devices. No gateways shall be used for communication to controllers installed under this section. Gateways may be used for communication to existing systems or to systems installed under other sections.
- B. The native BACnet EMS shall be as specified herein and consist of a high-speed, peer-to-peer local area network of DDC controllers connected to a dedicated Server PC and other client workstation PC's and Lap Top computers as specified. All HVAC and/or Electrical system points monitored and controlled by the EMS, including the building floor plans as well as all control devices, will be depicted by point-and-click graphics.
- C. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers. All controller devices must be BTL tested and listed by the official BACnet Testing Laboratory, having the BTL approval mark issued.
- D. All devices in this new project facility location shall be accessible from a single graphical user interface.
- E. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
- F. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
- G. Furnish and install the required software to produce a complete and operational native BACnet EMS as specified herein.
- H. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.
- I. Provide supervisory specialists, including a dedicated project manager, and technicians throughout the duration of the project to assist in all phases of EMS system installation, startup, and commissioning.
- J. Provide a comprehensive operator and technician training program as described herein.
- K. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.

#### 1.02 SYSTEM DESCRIPTION

- A. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be completely based on ANSI/ASHRAE Standard 135-2008, BACnet and achieved listing under the BACnet Testing Laboratories BACnet - Advanced Workstation Software (B-AWS). This system is to control all mechanical equipment, including all unitary equipment such as heat pumps, fan-coils, AC units, etc., and all air handlers, boilers, cooling towers, and any other listed equipment using native BACnet-compliant components. Non-BACnet-compliant or proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited.

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- B. Operator's workstation software shall be 64-bit operating system running Windows 10 as the computer operating system. The Energy Management System (EMS) application program shall be written to communicate specifically utilizing BACnet protocols. Software functions delivered on this project shall include password protection, scheduling (including optimum start), alarming, logging of historical data, full graphics including animation, after-hours billing program, demand limiting, and a full suite of field engineering tools including graphical programming and applications. Systems using operating systems other than that described above are strictly prohibited. All software required to program EMS application specific controllers and all field level devices and controllers will be left with the owner. All software passwords required to program and make future changes to the system will also become the property of the owner. All software required to make any program changes anywhere in the system, along with scheduling and trending applications, will be left with the owner. All software passwords required to program and make future changes to schedules, trends and related program changes will also become the property of the owner. All software required for all field engineering tools including graphical programming and applications will be left with the owner. All software passwords required to program and make future changes to field engineering tools, including graphical programming and applications will be left with the owner.
- C. Building controllers shall include complete energy management software, including scheduling building control strategies with optimum start and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the operator's terminal. Operator's terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.
- D. All application controllers for every terminal unit (HP, UV, etc.), air handler, all central plant equipment, and any other piece of controlled equipment shall be fully programmable. Application controllers shall be mounted next to controlled equipment and communicate with building controller through BACnet LAN.
- E. System Architecture
  - 1. EMS Contractor shall utilize Owner's IT WAN for connection from BACnet Server to all Global Controllers furnished and installed as part of this project. Connection shall be by way of BACnet/IP as defined in Addendum A (Annex J) of the ANSI/ASHRAE Standard for BACnet. Connection between all Integration Level Global Controllers, the BACnet Server and any client work stations (PC's or Lap Tops) shall be high-speed, peer-to-peer Ethernet as per Standard IEEE802.3. Owner shall furnish and maintain IT WAN infrastructure.
  - 2. EMS Contractor shall provide and install a dedicated MS/TP LAN extending from all Global Controller's to distributed field level controller BACnet devices.
  - 3. Distributed field level controllers are responsible for directly controlling and monitoring HVAC and Electrical system points throughout the facility.
  - 4. The BACnet Server hosts system configurations, programming databases and stores all trendlog data. The Server maintains all backup files for system configuration and programming located on Global Controller's and field level controllers and is capable of directly uploading or downloading information from the controllers.
  - 5. An operator's workstation and/or any designated portable operator's terminal (if specified) shall be used as a graphical user interface to provide system supervision, management report generation and alarm annunciation.

### 1.03 APPROVED MANUFACTURERS

- A. Approved Control Manufacturers:
  - 1. **Delta Controls; by Syserco**

### 1.04 QUALITY ASSURANCE

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- A. The Contractor shall be regularly engaged in the manufacturing, installation and maintenance of EMS systems and shall have demonstrated technical expertise and experience in the manufacture, installation and maintenance of EMS systems similar in size and complexity to this project.
- B. The EMS system shall be designed, installed, commissioned, and serviced by manufacturer-authorized and trained personnel. System provider shall have an in-place support facility within 50 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment.
- C. To provide the level of support and response required by the Owner, the Energy Management System Contractor shall have a fully staffed service department with the following minimum personnel and service offerings:
  - 1. Minimum of 1 (one) Dedicated Support Technician located at a fixed location with access to a network for remote access to the site.
  - 2. Minimum of 1 (one) Dedicated Service Dispatcher to route calls and prioritize service response.
  - 3. Minimum of 5 (five) Dedicated Field Service Technicians. To ensure that there are personnel available to respond to service requests in a timely manner, these technicians are to be dedicated to service and not used on construction projects.
  - 4. Maintain a 24/7 Service Call Center staffed by live operators enabling immediate response to Owner's critical emergency EMS concerns.
- D. The EMS Contractor shall provide an on-site, experienced project manager for this work who is responsible for direct supervision of the installation, start up and commissioning of the EMS system.
- E. EMS Contractor shall have a proven record of successful native BACnet installations and maintenance of equivalent native BACnet systems for a minimum period of 5 years utilizing the same native BACnet manufacturer's product line that the Contractor proposes to use on this project.
- F. Materials and equipment shall be manufacturer's latest standard design that complies with the specification requirements.
- G. All BAS peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category PAZX.
- H. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.

#### **1.05 REFERENCE STANDARDS**

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
  - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
  - 2. ANSI/ASHRAE Standard 135-2008, BACnet.
  - 3. (Not used)
  - 4. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
  - 5. California Electrical Code (CEC).
  - 6. FCC Part 15, Subpart J, Class A.
  - 7. EMC Directive 89/336/EEC (European CE Mark).
  - 8. UL-864 UUKL listing for Smoke Controls for any equipment used in smoke control sequences.
- B. City, county, state, and federal regulations and codes in effect as of contract date.
- C. Except as otherwise indicated, the system supplier shall secure and pay for all permits, inspections, and certifications required for his work, and arrange for necessary approvals by the governing authorities.

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## 1.06 SUBMITTALS

- A. Drawings
  - 1. The system supplier shall submit engineered drawings, control sequence, and bill of materials for approval.
  - 2. Drawings shall be submitted in the following standard sizes: 11" x 17" (ANSI B).
  - 3. Eight (8) complete sets (copies) of submittal drawings shall be provided.
  - 4. Drawings shall be available on CD-ROM.
- B. System Documentation
 

Include the following in submittal package:

  - 1. System configuration diagrams in simplified block format.
  - 2. All input/output object listings and an alarm point summary listing.
  - 3. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
  - 4. Complete bill of materials, valve schedule and damper schedule.
  - 5. Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.
  - 6. Overall system operation and maintenance instructions—including preventive maintenance and troubleshooting instructions.
  - 7. For all system elements—building controller(s), application controllers, routers, and repeaters—provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135-2001.
  - 8. Provide complete description and documentation of any proprietary (non-BACnet) services and/or objects used in the system.
  - 9. A list of all functions available and a sample of function block programming that shall be part of delivered system.

## 1.07 WARRANTY

- A. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one (1) year from completion of system acceptance.
- B. **Extended Warranty – Years 2 to 5. For Characterized Control Valves (CCV), Globe Valves, Butterfly Valves, associated Valve Actuators and Damper Actuators, provide like kind replacement components for any defective material identified and returned in Years 2 to 5 from the date of system acceptance.**
- C. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor.
- D. This warranty shall apply equally to both hardware and software. This warranty shall apply equally to both hardware and software.

## 1.08 RELATED WORK IN OTHER SECTIONS

- A. Refer to Division 0 and Division 1 for related contractual requirements.
- B. Refer to Section 23 00 00 for General Mechanical Provisions.
- C. Refer to Section 26 00 00 for General Electrical Provisions.

## PART 2 - PRODUCTS

### 2.01 CONTROL PROGRAMMING SOFTWARE

- A. All DDC programming throughout the EMS network shall adhere to the following standards:
  - 1. Programming on all controllers must be completely operator definable and modifiable and must use a single common programming language for all control devices. Use of pre-canned, factory burned-in DDC programming on controllers is not acceptable and is grounds for rejection of EMS system.

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2. Programming shall be developed in an object-oriented graphical programming environment. Line by line code programming is specifically prohibited and is not acceptable.
3. Programming must accommodate all written sequences of operations.
4. Programming shall be modifiable from any server PC, operator console PC and/or portable laptop PC workstation without requiring the burning of new chips or having to directly access the local controller. Software shall accommodate the downloading of programming via established network Ethernet or modem connections.
5. Programming must support the use of virtual software points in the same manner as all physical points are supported.
6. All programming points, virtual or real, for any specific device in the entire EMS network shall be accessible to all other network devices at any given time, regardless of physical location.
7. All programming shall adhere to the BACnet protocols for Standard Command Priorities.
8. Programming software must include a pre-developed cohesive PID (proportional-integral-derivative) algorithm whereby a user can adjust gain and anti-windup coefficients accordingly to effectively accomplish advanced sequence of operation requirements.

## **2.02 ADVANCED APPLICATION CONTROLLERS**

- A. Provide one or more native BACnet advanced application controllers for HVAC equipment requiring DDC standalone control independent of building control module operation. All controllers shall interface to building controller through either MS/TP LAN using BACnet protocol, or Ethernet LAN using BACnet over Ethernet or BACnet TCP/IP. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable using graphical programming blocks. Programming tool shall be resident on operator workstation and be the same tool as used for the building controller. No auxiliary or non-BACnet controllers shall be used.
- B. BACnet Conformance
  1. Application controllers shall be approved by the BTL as meeting the BACnet Advanced Application Controller requirements.
  2. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
  3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Multi-state Values, Device, File, and Program object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- C. Application controllers shall include universal inputs with 12-bit resolution that accept 3K and 10K thermistors, 0–10VDC, Platinum 1000 Ohm RTD, 0–5VDC, 4–20mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of three (3) inputs that accept pulses. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall include binary and analog outputs on board. Analog outputs with 12-bit resolution shall support either 0–10VDC or 0–20mA. Binary outputs shall have LED indication of status. Software shall include scaling features for analog outputs. Application controller shall include 20VDC voltage supply for use as power supply to external sensors.
  1. All outputs must have on-board Hand-Off-Auto (HOA) switches and a status indicator light. HOA switch position shall be monitored. Each analog output shall include a potentiometer for manually adjusting the output when the HOA switch is in the Hand position. The position of each and every HOA switch shall be available system wide as a BACnet object property.

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- D. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller up to 20 times per second (minimum of 10 times per second) and capable of multiple PID loops for control of multiple devices. All calculations shall be completed using floating-point math and system shall support display of all information in floating-point nomenclature at operator's terminal.
1. The following control blocks shall be supported:
    - a. Natural Log
    - b. Exponential
    - c. Log base 10
    - d. X to the power of Y
    - e. Nth square root of X
    - f. 5th Order Polynomial Equations
    - g. Astronomical Clock (sunrise/sunset calculation)
    - h. Time-based schedules
- E. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely using modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using programming tools as described in operator's terminal section.
- F. Application controller shall include support for intelligent room sensor (see Section 2.9.B.) Display on intelligent room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode, based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.
- G. Schedules
1. The controller shall support a minimum of three (3) BACnet Schedule Objects and have a real-time clock on board with battery backup to maintain time through a power loss.
- H. Logging Capabilities
1. Controller shall support a minimum of 50 trendlogs. Any object in the controller (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
  2. Controller shall periodically upload trended data to system server for long-term archiving if desired. Archived data stored in (MS Jet Database or SQL) database form and shall be available for use in third-party spreadsheet or database programs.
- I. Alarm Generation
1. Alarms may be generated within the controller for any object change of value or state (either real or calculated). This includes things such as analog object value changes, and binary object state changes.
  2. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
  3. Controller must be able to handle up to 25 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.
- J. The controller processor shall be a 32-bit processor.
- K. The packaging of the controller shall provide operable doors to cover the terminals once installation is complete. The housing of the controller shall provide for DIN rail mounting and also fully enclose circuit board.

## 2.03 APPLICATION SPECIFIC CONTROLLERS

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- A. Provide one (1) native BACnet application controller for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller through MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.
- B. BACnet Conformance
  1. Application controllers shall, as a minimum, support MS/TP BACnet LAN types. They shall communicate directly using this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall be approved by the BTL as meeting the BACnet Application Specific Controller requirements and support all BACnet services necessary to provide the following BACnet functional groups:
    - a. Files Functional Group
    - b. Reinitialize Functional Group
    - c. Device Communications Functional Group
  2. Please refer to Section 22.2, BACnet Functional Groups in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
  3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- C. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5VDC, 4–20mA, dry contact signals and a minimum of three (3) pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.
- D. All program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely through modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.
- E. Application controller shall include support for intelligent room sensor (see Section 2.9.B.) Display on room sensor shall be programmable at controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

## 2.04 AUXILIARY CONTROL DEVICES

- A. Temperature Sensors
  1. All temperature sensors to be solid-state electronic, interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Mount 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake, and in a location that is in the shade most of the day.

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B. Intelligent Room Sensor with Touch Screen

1. Hardware

- a. Room sensor shall include:
  - 1) Backlit touch screen LCD digital display
  - 2) Temperature sensor
  - 3) Humidity Sensor
  - 4) Programmable Status Light indicator
  - 5) CO2 Sensor (as scheduled on prints)
- b. Temperature sensor shall be a Uni-Cuve Type II thermistor with an accuracy of +/- 0.36 °F (0.2 °C) at calibration point over the range of 32-158 °F or better.
- c. Humidity sensor shall have an accuracy of +/-3% from 10-90% relative humidity or better.
- d. The intelligent room sensor's Smart Light shall have a minimum of four colors (Blue, Red, Amber and Green) that will cast a glow onto the wall below the sensor to be used as visual indicator to the occupants of the condition of the system. The color and on/off state of smart light shall be fully programmable.
- e. CO2 Sensor shall have an accuracy of +/- 30 ppm over the range of 0-5000 ppm or better.
- f. CO2 sensor shall utilize Automatic Baseline Correction to maintain sensor calibration without need for manual calibration.
- g. The user shall interact with the smart sensor using a touch screen, with no buttons allowed.
- h. The intelligent room sensor shall have provisions for a tamper proof installation requiring tools to be removed from the wall.
- i. The touch screen shall have a surface hardness of Mohs 7 or greater to prevent being easily scratched.
- j. Controller shall function as room control unit and allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator.

2. Display Content

- a. The intelligent room sensor shall simultaneously display room setpoint, room temperature, and outside temperature at each controller.
- b. The intelligent room sensor shall have the ability to add or remove from the display time-of-day, room humidity, and indoor air temp to customize the view for the customer.
- c. The intelligent room sensor must have the capability to show temperatures in degrees Fahrenheit or degrees Centigrade.
- d. A communication loss or improper communications wiring shall be displayed on the LCD screen to aid in trouble shooting.
- e. Information about the version of firmware shall be displayable on the LCD screen.
- f. A cleaning mode will be provided to allow for the touch screen to be cleaned without inadvertently making changes to system parameters.
- g. The intelligent room sensor shall have the ability to display the status of a lighting zone status and control the on/off state of the zone from the touch screen using a tenant accessible display page.
- h. The intelligent room sensor shall have the ability to display the status of a window zone (e.g. blinds) and control the on/off state of the zone from the touch screen using a tenant accessible display page.
- i. After Hours Override shall:
  - 1) Override time may be set and viewed in 30 minute increments.
  - 2) Override time countdown shall be automatic, but may be reset to zero by occupant from the sensor.
  - 3) Time remaining shall be displayed.

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- 4) Display shall show the word "OFF" in unoccupied mode unless a function button is pressed.
3. Other Modes
  - a. The intelligent room sensor shall also allow service technician access to hidden functions for advanced system configuration. This functionality shall be accessed protected with a configurable pin number.
  - b. Field service mode shall allow access to common parameters as dictated by the application's sequence of operations. The parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.
  - c. Balance mode shall, if intelligent room sensor is connected to VAV controller, allow a VAV box to be balanced and all air flow parameters viewed. The balancing parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.
4. Intelligent Room Sensor shall be in compliance of the following:
  - a. UL Standard for Safety 916
  - b. FCC Part 15.107 & 109, Class B, CFR47-15
  - c. EMC Directive 89/336/EEC (European CE Mark).
- C. Wall Sensor
  1. Standard wall sensor shall use solid-state sensor identical to intelligent room sensor and shall be packaged in aesthetically pleasing enclosure. Sensor shall provide override function, warmer/cooler lever for set point adjustment and port for plug-in of Field Service Tool for field adjustments. Override time shall be stored in controller and be adjustable on a zone-by-zone basis. Adjustment range for warmer/cooler lever shall also be stored in EEPROM on controller. All programmable variables shall be available to field service tool through wall sensor port.

## 2.05 ELECTRONIC ACTUATORS

- A. Quality Assurance for Actuators
  1. UL Listed Standard 873 and C.S.A. Class 4813 02 certified.
  2. NEMA 2 rated enclosures for inside mounting, provide with weather shield for outside mounting.
  3. Five-year manufacturer's warranty. Two-year unconditional and three-year product defect from date of installation.
- B. Actuators for dampers shall be electric unless otherwise specified, provide actuators as follows:
  1. UL Listed Standard 873 and Canadian Standards Association Class 481302 shall certify actuators.
  2. NEMA 2 rated actuator enclosures for inside mounting. Use additional weather shield to protect actuator when mounted outside.
  3. Five-year manufacturer's warranty. Two-year unconditional and three-year product defect from date of installation.
  4. Mechanical spring shall be provided when specified. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
  5. Position indicator device shall be installed and made visible to the exposed side of the actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the actuator.
  6. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for butterfly valve actuators.
  7. A pushbutton gearbox release shall be provided for all non-spring actuators.
  8. Modulating actuators shall be 24 VAC and consume 10 VA power or less.
  9. Conduit connectors are required when specified and when code requires it.
- C. Damper Actuators

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1. Economizer actuators shall utilize analog control 2–10 VDC; floating control is not acceptable.
2. Electric damper actuators (including VAV box actuators) shall be direct shaft-mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or set-screw type fasteners are not acceptable.
3. One (1) electronic actuator shall be direct shaft-mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one (1) actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
4. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One (1) electronic actuator shall be direct shaft-mounted per damper section. (See below execution section for more installation details.)

## **2.06 ENCLOSURES**

- A. All controllers, power supplies and relays shall be mounted in enclosures.
- B. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment. Outdoor enclosures must be either NEMA 3R or NEMA 4.
- C. All temperature control panels shall be fabricated in a UL-listed panel shop. Field assembled temperature control panels are not allowed.

## **PART 3: EXECUTION**

### **3.01 EXAMINATION**

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this section may properly commence.
  1. Notify the owner's representative in writing of conditions detrimental to the proper and timely completion of the work.
  2. Do not begin work until all unsatisfactory conditions are resolved.

### **3.02 INSTALLATION (GENERAL)**

- A. Install in accordance with manufacturer's instructions.
- B. Provide all miscellaneous devices, hardware, software, interconnections, installation, and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.

### **3.03 LOCATION AND INSTALLATION OF COMPONENTS**

- A. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum three (3) feet of clear access space in front of units. Obtain approval on locations from owner's representative prior to installation.
- B. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture, and high or low temperatures.
- C. Identify all equipment and panels. Provide permanently mounted tags for all panels.
- D. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections, and sized to suit pipe diameter without restricting flow.

### **3.04 INTERLOCKING AND CONTROL WIRING**

- A. Provide all interlock and control wiring associated with the EMS system. All wiring shall be installed neatly and professionally, in accordance with all national, state and local electrical codes.
- B. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.

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- C. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the owner's representative prior to rough-in.
- D. Provide auxiliary pilot duty relays on motor starters as required for control function.
- E. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings; coordinate with electrical contractor.
- F. All control wiring in mechanical, electrical, telephone and boiler rooms to be installed in raceways. All other control wiring to be installed without conduit neatly and inconspicuously per local code requirements.

### 3.05 DDC OBJECT TYPE SUMMARY

- A. Provide all database generation.
- B. Displays
  - 1. System displays shall show all analog and binary object types within the system. They shall be logically laid out for easy use by the owner. Provide outside air temperature indication on all system displays associated with economizer cycles.
- C. Run Time Totalization
  - 1. At a minimum, run time totalization shall be incorporated for each monitored supply fan, return fan, exhaust fan, hot water and chilled water pumps. Warning limits for each point shall be entered for alarm and or maintenance purposes.
- D. Trendlog
  - 1. All binary and analog object types (including zones) shall have the capability to be automatically trended.
- E. Alarm
  - 1. All analog inputs (High/Low Limits) and selected binary input alarm points shall be prioritized and routed (locally or remotely) with alarm message per owner's requirements.
- F. Database Save
  - 1. Provide backup database for all standalone application controllers on disk.

### 3.06 FIELD SERVICES

- A. Prepare and start logic control system under provisions of this section.
- B. Start up and commission systems. Allow sufficient time for startup and commissioning prior to placing control systems in permanent operation.
- C. Provide the capability for off-site monitoring at control contractor's local or main office. At a minimum, off-site facility shall be capable of system diagnostics and software download. Owner shall provide phone line for this service for one (1) year or as specified.
- D. Provide owner's representative with spare parts list. Identify equipment critical to maintaining the integrity of the operating system.

### 3.07 TRAINING

- A. Provide application engineer to instruct owner in operation of systems and equipment.
- B. Provide system operator's training to include (but not be limited to) such items as the following: modification of data displays, alarm and status descriptors, requesting data, execution of commands and request of logs. Provide this training to a minimum of three persons.
- C. Provide on-site training above as required, 24 hours as part of this contract.

### 3.08 DEMONSTRATION

- A. Demonstrate complete operating system to owner's representative.
- B. Provide certificate stating that control system has been tested and adjusted for proper operation.

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**END OF SECTION 23 0923**

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## SECTION 23 2300 REFRIGERANT PIPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Check valves.
- G. Pressure regulators.
- H. Pressure relief valves.
- I. Filter-driers.
- J. Solenoid valves.
- K. Expansion valves.
- L. Receivers.

#### 1.02 SYSTEM DESCRIPTION

- A. Provide pipe hangers and supports in accordance drawing details.
- B. Liquid Indicators:
  - 1. Use line size liquid indicators in main liquid line leaving condenser.
  - 2. If receiver is provided, install in liquid line leaving receiver.
  - 3. Use line size on leaving side of liquid solenoid valves.
- C. Valves:
  - 1. Use service valves on suction and discharge of compressors.
  - 2. Use gauge taps at compressor inlet and outlet.
  - 3. Use gauge taps at hot gas bypass regulators, inlet and outlet.
  - 4. Use check valves on compressor discharge.
- D. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.
- E. Strainers:
  - 1. Use line size strainer upstream of each automatic valve.
- F. Pressure Relief Valves: Use on ASME receivers and pipe to outdoors.
- G. Filter-Driers:
  - 1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.
- H. Solenoid Valves:
  - 1. Use in liquid line of systems operating with single pump-out or pump-down compressor control.
  - 2. Use in liquid line of single or multiple evaporator systems.

#### 1.03 SUBMITTALS

- A. **PRODUCT DATA:** Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers product data for all piping materials and accessories.
- B. **SHOP DRAWINGS:** Submit **SCALED SHOP drawing indicating overall pipe routing, fittings, gages, sizes, elevations, welds, and configuration PRIOR to release of fabrication for all piping systems.**

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- C. **TEST REPORTS:** Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate in accordance with 230593 Testing & Balancing & 232300 Section 3 Execution section below.
- D. Submit welders certification of compliance with ASME BPVC-IX.
- E. **AS BUILTS:** Provide electronic PDF scaled record as built drawings of exact locations of all piping, valves & associated equipment for owners records. As built shall include all contract document changes.

#### 1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum **TEN years** of documented experience, and approved by manufacturer.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum **TEN years** of documented experience.

#### 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 REGULATORY REQUIREMENTS

#### 2.02 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.
- B. Copper Tube to 7/8 inch OD: ASTM B88 (ASTM B88M), **Type L (A)**, annealed.
  - 1. Fittings: ASME B16.26 cast copper.
  - 2. Joints: Flared.
- C. Pipe Supports and Anchors:
  - 1. Provide hangers and supports that comply with MSS SP-58.
    - a. 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 Inch: Malleable iron adjustable swivel, split ring.
  - 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
  - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
  - 6. Vertical Support: Steel riser clamp.
  - 7. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - 8. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
  - 9. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
  - 10. 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.
  - 11. Rooftop Supports for Low-Slope Roofs: Steel pedestals with 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; and as follows:
    - a. Bases: High density, UV tolerant, polypropylene or reinforced PVC.

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- b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
- c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
- d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
- e. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.

### **2.03 MOISTURE AND LIQUID INDICATORS**

- A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

### **2.04 VALVES**

- A. Packed Angle Valves:
  - 1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- B. Ball Valves:
  - 1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.

### **2.05 STRAINERS**

- A. Straight Line or Angle Line Type:
  - 1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.

### **2.06 CHECK VALVES**

- A. Globe Type:
  - 1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F and maximum working pressure of 425 psi.
- B. Straight Through Type:
  - 1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 200 degrees F.

### **2.07 PRESSURE REGULATORS**

- A. Brass body, stainless steel diaphragm, direct acting, adjustable over 0 to 80 psi range, for maximum working pressure of 450 psi.

### **2.08 PRESSURE RELIEF VALVES**

- A. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected to ASHRAE Std 15, with standard setting of 235 psi.

### **2.09 SOLENOID VALVES**

- A. Valve: AHRI 760 I-P, pilot operated, copper, brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 500 psi.
- B. Coil Assembly: UL 429 UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.

### **2.10 EXPANSION VALVES**

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- A. Angle or Straight Through Type: AHRI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with non-replaceable capillary tube and remote sensing bulb and remote bulb well.
- B. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

## 2.11 ELECTRONIC EXPANSION VALVES

- A. Valve:
  - 1. Brass body with flared or solder connection, needle valve with floating needle and machined seat, stepper motor drive.
- B. Evaporation Control System:
  - 1. Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, preselection allowance for electrical defrost and hot gas bypass.
- C. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

## 2.12 RECEIVERS

- A. Internal Diameter 6 inch and Smaller:
  - 1. AHRI 495, UL listed, steel, brazed; 400 psi maximum pressure rating, with tappings for inlet, outlet, and pressure relief valve.

## 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 piping system 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. 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. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- G. Pipe Hangers and Supports:
  - 1. Install in accordance with ASME B31.5.
  - 2. Support horizontal piping as indicated.
  - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

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4. Place hangers within 12 inches of each horizontal elbow.
  5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
  6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  7. Provide copper plated hangers and supports for copper piping.
- H. **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.
- I. Provide clearance for installation of insulation and access to valves and fittings.
- J. Provide access to concealed valves and fittings. Coordinate size and location of access doors with Section 08 3100.
- K. Flood piping system **with nitrogen** when brazing.
- L. Insulate piping per Specification Section 230719.
- M. Follow manufacturer's requirements for testing of refrigerant systems for pressure & final vacuum limits prior to final charge of system. Minimum line test pressure performance requirements are:
1. **Suction lines for heat pump applications - 325 PSIG**
  2. **Hot Gas & Liquid Lines - 325 PSIG**
- N. Fully charge completed system with refrigerant after testing.

### 3.03 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
  2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.
  3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.

**END OF SECTION 23 2300**

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## SECTION 23 3100 HVAC DUCTS AND CASINGS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Metal ductwork.
- B. Casing and plenums.

#### 1.02 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
- C. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- D. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012, 2nd Edition.
- E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.
- F. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual.
- G. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.

#### 1.03 SUBMITTALS

- A. **PRODUCT DATA:** Provide data for duct materials.
- B. **SHOP DRAWINGS:** Submit **SCALED SHOP** drawing indicating overall ductwork routing, fittings, gages, sizes, elevations, welds, and configuration **PRIOR** to release of fabrication for all ductwork systems.
- C. **TEST REPORTS:** Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate in accordance with 230593 Testing & Balancing.
- D. **AS BUILTS:** Provide electronic PDF scaled record as built drawings of exact locations of all ductwork & associated equipment for owners records. As built shall include all contract document changes including RFC/RFIs, CCDs, and all post bid contract drawing changes.

#### 1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum **TEN years** of documented experience, and approved by manufacturer.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum **TEN years** of documented experience.

#### 1.05 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.
- C. **Protect inner ductwork from weather** and construction traffic, dirt, or water by wrapping all ductwork ends with temporary protective polyethylene blue film, LLDPE 3 millimeters thick or similar. Remove temporary film at ends **only when** ductwork system installed in overhead, and connected to other fittings.

### PART 2 PRODUCTS

#### 2.01 DUCT ASSEMBLIES

- A. Regulatory Requirements: Construct ductwork to comply with **SMACNA DCS Standards**.
- B. Ducts: Galvanized steel, unless otherwise indicated here within or on contract drawings.

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- C. **Low Pressure Supply: 1/2 inch w.g. pressure class, galvanized steel.**
- D. **Medium and High Pressure Supply: 2 in w.g. pressure class or as per drawing schedule, galvanized steel. More stringent value shall apply.**
- E. **Type I Kitchen Hood Grease Exhaust: 1/2 inch w.g. pressure class, stainless steel.**
  - 1. **Construct of 18 gage, 0.0500 inch stainless steel.**
  - 2. **Construction:**
    - a. **Liquid tight with continuous external weld for all seams and joints.**
    - b. **Pitch ductwork back towards kitchen hood, 1/4" per foot slope**
  - 3. **Access Doors:**
    - a. Provide for duct cleaning inside horizontal duct at drain pockets, every 20 feet and at each change of direction. See plans for additional access door requirements.
    - b. Use same material and thickness as duct with gaskets and sealants rated 1500 degrees F for grease tight construction.
  - 4. **Drains**
    - a. Provide grease drains & traps at bottom of vertical risers should offset occur with provisions for clean out.
- F. **Chemical Storage Exhaust: 1/2 inch w.g. pressure class, CPVC.**

## 2.02 MATERIALS

- A. **Galvanized Steel for Ducts:** Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- B. **Stainless Steel for Ducts:** ASTM A666, Type 304.
- C. **Joint Sealers and Sealants:** Non-hardening, water resistant, mildew and mold resistant.
  - 1. **CONCEALED DUCTWORK:**
    - a. Provide 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. **EXPOSED DUCTWORK:**
    - a. All fittings sealed from inside
    - b. Provide painters tape each end to seal
    - c. Use clear silicone, similar to Loctite Translucent
  - 3. **VOC Content:** Not more than 250 g/L, excluding water.
  - 4. **Surface Burning Characteristics:** Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
- 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 Wedge Expansion Anchors:** Complying with ICC-ES AC193.
  - 2. **Masonry Wedge Expansion Anchors:** Complying with ICC-ES AC01.
  - 3. **Concrete Screw Type Anchors:** Complying with ICC-ES AC193.
  - 4. **Masonry Screw Type Anchors:** Complying with ICC-ES AC106.
  - 5. **Concrete Adhesive Type Anchors:** Complying with ICC-ES AC308.
  - 6. **Other Types:** As required.

## 2.03 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.
- B. **PAINTING:** When painting exposed ductwork, contractor to request ductwork have galvanized/paintlock from fabricator.
- C. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

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- 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. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

## 2.04 MANUFACTURED DUCTWORK AND FITTINGS

- A. **DOUBLE WALL INSULATED RECTANGULAR DUCTS:** Rectangular duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with solid inner wall and 2 inch lining minimum R value of R=8.0. Top of duct shall have hat channel to pitch water to sides of duct.
  - 1. Manufacture in accordance with SMACNA (DCS).
  - 2. Manufacturing shall occur by 3rd party manufacturing facility
  - 3. Fittings: Manufacture at least two gages heavier metal than duct.
- B. **FLAT OVAL & SPIRAL ROUND DUCTWORK:** Spiral lockseam duct with galvanized steel outer wall.
  - 1. Fittings: Manufacture at least two gages heavier metal than duct.
  - 2. **EXPOSED DUCTWORK**
    - a. Ductwork that will be painted, provide galvanized/paintlock from fabricator
    - b. All fittings sealed from inside
    - c. Provide painters tape each end to seal
    - d. Use clear silicone, similar to Loctite Translucent
  - 3. Manufacture in accordance with SMACNA (DCS).
- C. **FLEXIBLE DUCTS:** Two ply vinyl, polyethylene, or nylon film supported by helically wound spring steel wire.
  - 1. Insulation: Fiberglass insulation with aluminized vapor barrier film.
  - 2. Minimum Pressure Rating: **2" WG positive and 0.5" WG negative.**
  - 3. Maximum Velocity: 4000 fpm.
  - 4. Temperature Range: Minus 10 degrees F to 160 degrees F.
  - 5. Manufacturers:
    - a. Casco, Silentflex II.
    - b. Flexmaster, Type 1M or Type 6M.
    - c. Substitutions: **As Approved**
- D. **ACOUSTICAL FLEXIBLE DUCTS:** UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
  - 1. Insulation: Fiberglass insulation with reinforced vapor barrier.
  - 2. Inner Core: Spun-bonded, non-woven inner core.
  - 3. **Pressure Rating: 6 inches positive and 1.0 inches WG negative.**
  - 4. Maximum Velocity: 4000 fpm.
  - 5. Temperature Range: Minus 20 degrees F to 210 degrees F.
  - 6. **Acceptable Manufacturers:**
    - a. **Flexmaster USA Type 6M**
    - b. **Thermaxflex MKE**
    - c. **JPL AMR-25**
    - d. **Quiteflex QAS**

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- E. **Transverse Duct Connection System:** SMACNA "E" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
- F. **Type 1 Kitchen Hood Grease Exhaust:** Wrap kitchen ductwork with nominal 3 inches thick ceramic fiber insulation between 20 gage, 0.0375 inch, Type 304 stainless steel liner and 24 gage, 0.0239 inch aluminized steel sheet outer jacket, similar to 3M Fire Wrap. Fire resistant blanket shall have 2hr rating, and UL Listed product.
  - 1. Tested and UL listed for use with commercial cooking equipment in accordance with NFPA 96.
  - 2. Certified for zero clearance to combustible material in accordance with:
  - 3. Materials and construction of the modular sections and accessories to be in accordance with the terms of the following listings:
- G. **Boiler or Chemical Storage Exhaust:** Minimum Schedule 40 thick, single wall, CPVC
  - 1. Designed, fabricated, and installed to be liquid tight preventing exhaust leakage into the building.
  - 2. Joints to be sealed during installation with solvent cement
  - 3. Manufacturers:
    - a. ChemDrain, By Charlotte Pipe

## 2.05 CASINGS

- A. Fabricate casings in accordance with SMACNA (DCS) and construct for operating pressures indicated.
- B. Mount floor mounted casings on 4 inch high concrete curbs. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, provide liner of galvanized 18 gage, 0.0478 inch expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.
- C. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.

## 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. **TEMPORARY PROTECTION:** During construction protect inner ductwork from weather and construction traffic, dirt, or water **by wrapping all ductwork ends** with temporary protective polyethylene blue film, LLDPE 3 millimeters thick or similar. Remove temporary film at ends only when ductwork system installed in overhead, and connected to other fittings.
- D. Exposed, Painted Ductwork: Prior to painting prepare ductwork surface by cleaning with water-based detergent to remove residual dirt and lubricating oils and wipe dry with lint free cloth.
- E. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- F. 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.
- G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- 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.

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J. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

### **3.02 DUCT LEAKAGE TESTING**

- A. **Testing shall be in accordance with Specification 230593 Testing & Balancing**
- B. **Testing shall be performed by TAB Certified Subcontractor**, per specification above.
- C. **Perform duct leakage testing for ALL DUCTWORK designed.**
  - 1. Representative sections totaling not less than 10% of the total installed duct area for the designated pressure class shall be tested
  - 2. Positive pressure testing is acceptable for negative pressure ductwork.

**END OF SECTION 23 3100**

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## SECTION 23 3300 AIR DUCT ACCESSORIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Backdraft dampers
- B. Combination fire and smoke dampers.
- C. Duct test holes.
- D. Flexible duct connections.
- E. Manual volume control dampers
- F. Remote actuated electronic volume control dampers.

#### 1.02 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
- B. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association
- C. NFPA 92 - Standard for Smoke Control Systems.
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.
- E. UL 33 - Safety Heat Responsive Links for Fire-Protection Service.
- F. UL 555 - Standard for Fire Dampers.
- G. UL 555S - Standard for Smoke Dampers.

#### 1.03 SUBMITTALS

- A. **PRODUCT DATA:** Provide dimensions of manufactured products and assemblies required for this project. Indicate electrical service with wiring diagrams & unit connection requirements.
- B. **INSTALLATION INSTRUCTIONS:** Indicate assembly, support details, connection requirements, and include start-up instructions for all fire smoke dampers & electronic dampers as required..

#### 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.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- C. Comply with NFPA 90A and NFPA 90B.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

### PART 2 PRODUCTS

#### 2.01 BACKDRAFT DAMPERS - METAL

- A. **Manufacturers:**
  - 1. **Pottorff**
  - 2. **Greenheck**
  - 3. **Nailor Industries, Inc**
  - 4. **Ruskin Company**
- B. Gravity Backdraft Dampers, Size 18 by 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

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- C. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

## 2.02 COMBINATION FIRE AND SMOKE DAMPERS

- A. **Manufacturers:**
1. **Pottorff**
  2. **Greenheck**
  3. **Nailor Industries Inc**
  4. **Ruskin Company**
- B. Ratings:
1. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
  2. Fire Rating: 1-1/2 hours or 3-hours in accordance with UL-555. **Ratings required per wall rating shown on plans.**
  3. Smoke Rating: Class-2 (20 cfm/sf at 4 in wg) leakage in accordance with UL-555S
  4. Air Flow Rating: 2000 fpm
  5. Differential Pressure Rating: 4 in.wg.
- C. Provide factory sleeve and collar for each damper.
- D. Construction:
1. Frame: Hat-shaped channel, roll formed galvanized steel with interlocking gusseted corners. Structurally equivalent to 13 gauge (2.3mm) U-channel type frame. Low profile head and sill on sizes less than 13 inches (330 mm) high.
  2. Blades: 6 inch maximum width x 16 gauge (152mm x 1.6mm), 3-V shape, roll formed galvanized steel.
  3. Blade Seals: Silicone rubber permanently bonded to blade.
  4. Jamb Seals: Stainless steel, flexible metal compression type.
  5. Axels: Minimum 1/2" (13mm) diameter plated steel hex-shaped, mechanically attached to blade.
  6. Bearings: Self-lubricating stainless steel, sleeve-type turning in extruded hole in frame.
  7. Linkage: Concealed in frame.
  8. Fire Closure Device: Resettable
  9. Release Temperature: 165 F
  10. Mounting: Vertical and/or Horizontal (1 1/2 hour rated only)
  11. Sleeve: Standard 16 inches long x 20 gauge (406mm x 1.0mm), factory installed.
  12. Actuator: Electric 120 V, 60 Hz, two-position, fail close, external mount
- E. Position Indicator Switch Package: Shall connect directly to the blade axel for positive annunciation (interconnecting arms, wire-forms, or brackets shall not be accepted) and provide full open and full closed blade indication to a remote location.
- F. Damper shall be controlled by area wide smoke and fire detection and alarm system. Coordinate with **Section 28 4600 Fire Detection and Alarm System**

## 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 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Flexible Duct Connections: Fabric crimped into metal edging strip.

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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 gage, 0.0239 inch thick galvanized steel.
- C. Maximum Installed Length: 14 inch.

## 2.05 MANUAL VOLUME CONTROL DAMPERS

- A. Application: Provide Manual Volume Control Dampers for any balancing damper located in an accessible location.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Splitter Dampers:
  1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
  2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
  3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw .
- D. Single Blade Dampers:
  1. Fabricate for duct sizes up to 6 by 30 inch.
  2. Blade: 24 gage, 0.0239 inch, minimum.
- E. 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 gage, 0.0478 inch, minimum.
- F. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

## 2.06 REMOTE ACTUATED ELECTRONIC VOLUME CONTROL DAMPERS

- A. Application: Provide battery powered, low-voltage Remote Actuated Volume Control Dampers for any balancing damper located in hard ceiling or inaccessible locations per drawing detail.
- B. **Manufacturers:**
  1. **Greenheck - RBD Series**
  2. **Young's Regulator - EBD Series**
  3. **Metropolitan Air Technology - EB-250 Series with EB-SP8 Controller**
  4. **Ruskin - ZPD Series**
- C. Description: Balancing Damper actuated by a low voltage (9V or 12V) DC motor for use above hard ceilings and in other inaccessible locations. Remote controller provides power, control and damper position feedback via a cable of up to 500 feet.
- D. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- E. Shell: Galvanized steel, 24 gage minimum.
- F. Blade: Galvanized steel, 20 gage minimum.
- G. Shaft: 1/2" Plated Steel
- H. Bushing: Oil Impregnated Bronze
- I. Controller: Hand held, battery powered controller, with position indicator.
- J. **Wall/Ceiling Termination:** Concealed and located as indicated on Drawings. If termination is not indicated on Drawings, locate termination in concealed, accessible ceiling areas, or if not feasible, locate termination recessed in hard ceiling with escutcheon plate to match ceiling color. **Termination block shall have multiple ports**, collecting all dampers to respective room controller.

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## **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 3100 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 access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 8 by 8 inch size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers, combination fire and smoke dampers, 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.
- F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
- G. Demonstrate re-setting of fire dampers to Owner's representative.
- H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- J. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- K. Use splitter dampers only where indicated.
- L. 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 23 3300**

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## SECTION 23 3423 HVAC POWER VENTILATORS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Roof exhausters.
- B. Cabinet exhaust fans.
- C. Upblast roof exhausters.
- D. Inline centrifugal fans.
- E. Kitchen hood upblast roof exhausters.

#### 1.02 REFERENCE STANDARDS

- A. AMCA 99 - Standards Handbook.
- B. AMCA 204 - Balance Quality and Vibration Levels for Fans.
- C. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
- D. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
- E. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- G. UL 705 - Power Ventilators.

#### 1.03 SUBMITTALS

- A. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements **per drawing schedules & plans**.
- B. Manufacturer's Instructions: Indicate installation instructions.
- C. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Fan Belts: Two sets for each individual fan.

#### 1.04 FIELD CONDITIONS

- A. Delivery: Deliver materials to site in manufacturer's original unopened containers
- B. Storage: Store materials in a dry area indoor, protected from damage and in accordance with manufacturer's instructions;
- C. Handling: Handle and lift fans in accordance with the manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.
- D. Permanent ventilators may not be used for ventilation during construction.

#### 1.05 WARRANTY

- A. Provide owner with one (1) year manufacturer's warranty for all equipment components including fan motor from date of owner's acceptance.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Greenheck Fan Corporation / NSWC
- B. Loren Cook Company / Haldeman, Inc
- C. Twin City Fan & Blower / Toro Aire
- D. Substitutions: See Section 01 6000 - Product Requirements.

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## 2.02 POWER VENTILATORS - GENERAL

- A. Static and Dynamically Balanced: AMCA 204 - Balance Quality and Vibration Levels for Fans.
- B. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
- C. Sound Ratings: AMCA 301, tested to AMCA 300 and bearing AMCA Certified Sound Rating Seal.
- D. Fabrication: Conform to AMCA 99.
- E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

## 2.03 ROOF EXHAUSTERS

### 2.04 CABINET EXHAUST FANS

- A. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
- B. Grille: Molded white plastic.
- C. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

### 2.05 UPBLAST ROOF EXHAUSTERS

- A. Performance Ratings: Refer to drawing schedules
- B. Direct Drive Fan:
  - 1. Fan Wheel:
    - a. Type: Non-overloading, backward inclined centrifugal.
    - b. Wheel Material: Aluminum.
  - 2. Statically and dynamically balanced.
  - 3. Motors:
    - a. Electronically Communicated Motor (ECM) Type
    - b. Enclosures: Open Type.
    - c. Heavy duty ball bearing type.
    - d. Controller: Shall be speed controllable down to 20% of full speed, 80% turndown. Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
    - e. Mount on vibration isolators or resilient cradle mounts, out of air stream.
    - f. Cover: Aluminum
    - g. Fully accessible for maintenance.
  - 4. Housing:
    - a. Construct of heavy gage aluminum including curb cap, windband, and motor compartment.
    - b. Rigid internal support structure.
    - c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
    - d. Construct drive frame assembly of heavy gage steel, mounted on vibration isolators.
    - e. Provide breather tube for fresh air motor cooling and wiring.
- C. Disconnect Switches:
  - 1. Factory mounted and wired.
  - 2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Outdoor Locations: Type 3R.
  - 3. Finish for Painted Steel Enclosures: Provide manufacturer's standard or factory applied gray unless otherwise indicated.

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4. Positive electrical shutoff.
5. Wired from fan motor to junction box installed within motor compartment.
- D. Roof Curb: 14 inch high self-flashing of aluminum with continuously welded seams, factory installed nailer strip.
- E. Drain Trough: Allows for single-point drainage of water, grease, and other residues.
- F. Options/Accessories:
  1. Birdscreen:
    - a. Provide galvanized steel construction.
    - b. Protects fan discharge.
  2. Dampers: Provide gravity type.
  3. Drain Connection:
    - a. Aluminum construction.
    - b. Allows single-point drainage of grease, water, or other residues.
  4. Finishes: Hi Pro Polyester, corrosion resistant powder coating.
  5. Hinge Sub-Base:
    - a. Aluminum hinges.
    - b. Hinges and restraint cables mounted to base (sleeve).
    - c. Allows fan to tilt away for access to wheel and ductwork for inspection and cleaning.

## 2.06 INLINE CENTRIFUGAL FANS

- A. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
- B. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

## 2.07 KITCHEN HOOD UPBLAST ROOF EXHAUSTERS

- A. Direct Drive Fan:
  1. Fan Wheel:
    - a. Type: Non-overloading, backward inclined centrifugal.
    - b. Material: Aluminum.
  2. Statically and dynamically balanced.
  3. Motors:
    - a. Open drip-proof (ODP).
    - b. Heavy duty ball bearing type.
    - c. Mount on vibration isolators or resilient cradle mounts, out of air stream.
    - d. Fully accessible for maintenance.
  4. Housing:
    - a. Construct of heavy gage aluminum including curb cap, windband, and motor compartment.
    - b. Rigid internal support structure.
    - c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
    - d. Construct drive frame assembly of heavy gage steel, mounted on vibration isolators.
    - e. Provide breather tube for fresh air motor cooling and wiring.
- B. Shafts and Bearings:
  1. Fan Shaft:
    - a. Ground and polished steel with anti-corrosive coating.
    - b. First critical speed at least 25 percent over maximum cataloged operating speed.
  2. Bearings:
    - a. Permanently sealed or pillow block type.

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- b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
  - c. 100 percent factory tested.
- C. Drive Assembly:
  - 1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
  - 2. Belts: Static free and oil resistant.
  - 3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
  - 4. Motor pulley adjustable for final system balancing.
  - 5. Readily accessible for maintenance.
- D. Drain Trough: Allows for single-point drainage of water, grease, and other residues.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
- D. Install backdraft dampers on inlet to roof and wall exhausters.
- E. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

#### **3.02 SCHEDULES**

- A. Refer to Drawings.

**END OF SECTION 23 3423**

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## SECTION 23 3700 AIR OUTLETS AND INLETS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Diffusers.
- B. Registers/grilles.

#### 1.02 REFERENCE STANDARDS

- A. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets.
- B. SMACNA (ASMM) - Architectural Sheet Metal Manual.
- C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

#### 1.03 SUBMITTALS

- A. 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.
- B. Project Record Documents: Record actual locations of air outlets and inlets.

#### 1.04 QUALITY ASSURANCE

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

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

- A. Refer to Drawings for air outlet and inlet requirements.

#### 2.02 MANUFACTURERS

- A. Price Industries: <https://www.priceindustries.com/>
- B. Krueger-HVAC, Division of Air System Components: [www.krueger-hvac.com/#sle](http://www.krueger-hvac.com/#sle).
- C. Titus, a brand of Air Distribution Technologies: [www.titus-hvac.com/#sle](http://www.titus-hvac.com/#sle).
- D. Tuttle and Bailey: [www.tuttleandbailey.com/#sle](http://www.tuttleandbailey.com/#sle).
- E. Anemostat HVAC
- F. Substitutions: See Section 01 6000 - Product Requirements.

#### 2.03 RECTANGULAR CEILING DIFFUSERS

- A. Type: Provide Square Plaque Type diffuser to discharge air in four way pattern with sectorizing baffles where indicated.
- B. Connections: Round.
- C. Frame: Provide Lay In Type, Exact Frame style to be confirmed during submittal.
- D. Fabrication: Aluminum with powder coat finish. Construction shall consist of a seamless, one-piece, precision formed backpan that incorporates a round inlet collar of sufficient length for connecting rigid or flexible duct. An inner plaque assembly shall be incorporated and shall drop no more than 1/4 inch below the ceiling plane to assure proper air distribution performance. The inner plaque assembly shall be completely removable from the room side to allow for full access to any dampers or other ductwork components located near the diffuser neck.
- E. Color: As selected by Architect from manufacturer's standard range.

#### 2.04 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with single deflection blades set at 0 degrees, vertical face.

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- B. Frame: 1-1/4 inch margin with countersunk screw mounting.
- C. Fabrication: Aluminum with 20 gage, 0.0359 inch minimum frames and 22 gage, 0.0299 inch minimum blades, aluminum with 20 gage, 0.0359 inch minimum frame & aluminum extrusions, with factory baked on powder coat finish.
- D. Color: To be selected by Architect from manufacturer's standard range.

## **2.05 CEILING LINEAR EXHAUST AND RETURN GRILLES**

- A. Type: Streamlined blades with 90 degree one-way deflection, 1/8 by 3/4 inch on 1/4 inch centers.
- B. Frame: 1-1/4 inch margin, extra heavy for floor mounting, with countersunk screw mounting.
- C. Fabrication: Steel with 20 gage, 0.0359 inch minimum frames and 22 gage, 0.0299 inch minimum blades, steel and aluminum with 20 gage, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Color: To be selected by Architect from manufacturer's standard range.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.
- C. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- D. Install diffusers to ductwork with air tight connection.
- E. 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.
- F. Paint ductwork visible behind air outlets and inlets matte black.

### **3.02 AIR OUTLET AND INLET SCHEDULE**

- A. Refer to Drawings.

**END OF SECTION 23 3700**

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## SECTION 23 3723 GRAVITY INTAKE VENTILATORS

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. Rooftop HVAC Gravity Intake Ventilators

#### 1.02 SUBMITTALS

- A. Provide dimensional drawings and product data
- B. Installation, Operation, and Maintenance Manual (IOM): Provide manufacturer's installation, operations, and maintenance manual, including instructions on installation, operations, maintenance, pulley adjustment, receiving, handling, storage, safety information and cleaning. A troubleshooting guide, parts list, warranty and electrical wiring diagrams

#### 1.03 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer, material, products included, and location of installation
- B. Storage: Store materials in a dry area indoor, protected from damage, and in accordance with manufacturer's instructions. For long term storage follow manufacturer's Installation, Operations, and Maintenance Manual
- C. Handling: Handle and lift fans in accordance with the manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage. Follow all safety warnings posted by the manufacturer

#### 1.04 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents
- B. The warranty of this equipment is to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at the Manufacturers option when returned to Manufacturer, transportation prepaid

#### 1.05 MAINTENANCE

- A. Refer to Manufacturer's Installation, Operation and Maintenance Manual (IOM), to find maintenance procedures

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURER

- A. Greenheck Fan Corporation: [www.greenheck.com/#sle](http://www.greenheck.com/#sle).
- B. Loren Cook Company: [www.lorencook.com/#sle](http://www.lorencook.com/#sle).
- C. Substitutions: See Section 016000 - Product Requirements.

#### 2.02 ALUMINUM INTAKE GRAVITY VENTILATOR

- A. General Description:
  1. Ventilator is low silhouette for intake applications with natural gravity or negative pressure system
  2. Each unit shall bear a permanently affixed manufacture's nameplate containing the model number and individual serial number
- B. Hood
  1. Constructed of aluminum
  2. Internal structure is constructed of galvanized steel

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- C. Birdscreen:
  - 1. Constructed of ½ inch **aluminum** mesh
  - 2. Mounted horizontally across the intake area of the hood
- D. Housing:
  - 1. Curb Cap type: Non-Hinged
  - 2. Constructed of aluminum, includes windband and curb cap. Galvanized material is not acceptable
  - 3. Windband to be one piece spun aluminum construction and maintain original material thickness throughout the housing.
  - 4. Windband to include an integral rolled bead for strength
  - 5. Curb cap to have integral deep spun inlet venturi and prepunched mounting holes to ensure correct attachment to roof.
- E. Options/Accessories:
  - 1. Roof Curbs:
    - a. Manufacturers standard roof curb.
    - b. Minimum height: 14"
    - c. Mounted onto roof
    - d. Material: Aluminum
    - e. Coating Type: Hi-Pro Polyester, corrosion resistant powder coating
  - 2. Dampers:
    - a. Type: Gravity
    - b. Balanced for minimal resistance to flow
    - c. Galvanized frames with prepunched mounting holes
  - 3. Finish:
    - a. Coating Type: **Hi-Pro Polyester, corrosion resistant powder coating**
  - 4. Flashing Flange:
    - a. Constructed of aluminum
    - b. Pre-punched holes for installation without a roof curb
  - 5. Hood Insulation:
    - a. Lined with 1" fiberglass insulation to prevent condensation and sound levels
  - 6. Insect Screen
    - a. Constructed of fine mesh aluminum
    - b. Fitted to the top of the throat and prevents entry of insects
  - 7. Tie-Down Points:
    - a. Four aluminum brackets located on windband secures fan in heavy wind applications

## **PART 3 - EXECUTION**

### **3.01 MANUFACTURER'S INSTRUCTIONS**

- A. Compliance: Comply with manufacturer's product data, including technical bulletins, product catalog installation instructions

### **3.02 EXAMINATION**

- A. Examine areas to receive fans. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization and maintenance of fans. Do not proceed with installation until unsatisfactory conditions are corrected

### **3.03 PREPARATION**

- A. Ensure roof openings are square, accurately aligned, correctly located, and in tolerance
- B. Ensure duct is plumb, sized correctly, and to proper elevation above roof deck. Install duct as specified in Air Distribution (Division 23)

### **3.04 INSTALLATION**

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- A. Install system as indicated on the Installation, Operation and Maintenance Manual (IOM) and contract drawings
- B. Install fans in accordance with manufacturer's instructions

### **3.05 ADJUSTING**

- A. Ventilators shall be adjusted according to manufacturer's instructions

### **3.06 CLEANING**

- A. Clean as recommended by manufacturer. Do not use material or methods which may damage finish surface or surrounding construction

### **3.07 PROTECTION**

- A. Protect installed product and finished surfaces from damage during construction
- B. Protect installed ventilators to ensure that, except for normal weathering, fans will be without damage or deterioration at time of substantial completion

**END OF SECTION 23 3723**

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## SECTION 23 4000 HVAC AIR CLEANING DEVICES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Disposable, extended area panel filters.
- B. Disposable panel filters.
- C. Filter gages.

#### 1.02 REFERENCE STANDARDS

- A. ASHRAE Std 52.1 - and Dust-Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.{ch#33}
- B. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- C. UL 900 - Standard for Air Filter Units.

#### 1.03 SUBMITTALS

- A. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.
- B. SHOP DRAWINGS: Indicate **filter sizes & location for all equipment in table/schedule format.**
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. **Filters provided for project shall include:**
    - a. One (1) MERV 6 for commissioning/startup that shall be discarded after testing is complete & prior to owner acceptance.
    - b. Two (2) MERV 14 filters of each type and size, one set placed within units and (1) extra set for owner storage.

#### 1.04 DELIVERY, STORAGE AND HANDLING

- A. **Accept materials on site** in original factory packaging, labeled with manufacturer's identification, including filter type and size.
- B. **Protect filters from weather** and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping on an elevated skid from floor.

### PART 2 PRODUCTS

#### 2.01 FILTER MANUFACTURERS

- A. American Filtration Inc: [www.americanfiltration.com/#sle](http://www.americanfiltration.com/#sle).
- B. AAF International/American Air Filter: [www.aafintl.com/#sle](http://www.aafintl.com/#sle).
- C. The Camfil Group: [www.camfilfarr.com/#sle](http://www.camfilfarr.com/#sle).

#### 2.02 DISPOSABLE, EXTENDED AREA PANEL FILTERS

- A. Media: UL 900 Class 1, pleated, lofted, non-woven, reinforced cotton fabric; supported and bonded to welded wire grid by corrugated aluminum separators.
  - 1. Frame: Non-flammable.
  - 2. **Nominal thickness: 2 inch or 4 inch**
- B. Minimum Efficiency Reporting Value (MERV): **14**, when tested in accordance with ASHRAE 52.2.
- C. Performance Rating, per ASHRAE Std 52.1:
  - 1. Initial resistance at 500 FPM face velocity: 0.20 inch WG.
  - 2. Recommended final resistance: 0.9 inch WG.

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### 2.03 DISPOSABLE PANEL FILTERS

- A. Media: UL 900 Class 2, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.
  - 1. Frame: Cardboard
  - 2. Nominal Thickness: **2 inch to 4 inch.**
- B. Minimum Efficiency Reporting Value (**MERV**): **6**, when tested in accordance with ASHRAE 52.2.
- C. Performance Rating:
  - 1. Initial Resistance at 500 FPM face velocity: 0.15 inch WG.
  - 2. Recommended Final Resistance: 0.50 inches WG.

### 2.04 FILTER GAGES

- A. Manufacturers:
  - 1. Dwyer Instruments, Inc: [www.dwyer-inst.com/#sle](http://www.dwyer-inst.com/#sle).
  - 2. Weiss Instruments: [www.weissinstruments.com/#sle](http://www.weissinstruments.com/#sle).
  - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Direct Reading Dial: 3-1/2 inch diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0-0.5 inch WG, 2 percent of full scale accuracy.
- C. Accessories: Static pressure tips with integral compression fittings, 1/4 inch aluminum tubing, 2-way or 3-way vent valves.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install air cleaning devices in accordance with manufacturer's instructions.
- B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.
- D. Provide filter gages on filter banks, installed with separate static pressure tips upstream and downstream of filters.

### 3.02 SCHEDULES:

- A. Refer to Drawings.

**END OF SECTION 23 4000**

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## SECTION 23 8126 SMALL-CAPACITY SPLIT-SYSTEM HEAT PUMPS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Air-source heat pumps.
- B. Air cooled condensing units.
- C. Indoor fan coil units for duct connection.
- D. Indoor ductless fan & ducted fan coil units.
- E. Refrigerant piping.
- F. Control Wiring

#### 1.02 REFERENCE STANDARDS

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
- B. AHRI 270 - Sound Performance Rating of Outdoor Unitary Equipment.
- C. AHRI 520 - Performance Rating of Positive Displacement Condensing Units.
- D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems.
- E. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant.
- F. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- G. NEMA MG 1 - Motors and Generators.
- H. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
- I. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- J. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical.

#### 1.03 SUBMITTALS

- A. **PRODUCT DATA:** Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with wiring diagrams & unit connection requirements.
- B. **Sustainable Design Documentation:** Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.
- C. **SHOP DRAWINGS:** Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
- D. **INSTALLATION INSTRUCTIONS:** Indicate rigging, assembly, support details, connection requirements, and include start-up instructions.
- E. **O&M MANUALS:** Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- F. **WARRANTY:** Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- G. **MAINTENANCE MATERIALS:** Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 234000 HVAC Air Cleaning Devices additional provisions.
  - 2. Filters provided for project shall include:
    - a. One (1) MERV 6 for commissioning/startup that shall be placed within unit once installed & discarded after testing is complete & prior to owner acceptance.

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- b. Two (2) MERV 14 filters of each type and size, one set placed within unit and (1) extra set for owner storage.

#### 1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum ten years of experience and approved by manufacturer.

#### 1.05 WARRANTY

- A. **Contractor shall provide the following warranty:**
  - 1. One year (1) labor warranty & guarantee on entire HVAC system (ductwork, pipes, etc) including split system equipment
  - 2. One year (1) labor & parts warranty period shall commence when Owner occupies building with Certificate of Occupancy Date
  - 3. Split System manufacturer shall provide twelve (12) month parts only warranty for all components within unit.
  - 4. Split System manufacturer shall provide extended sixty (60) month total parts only, warranty on the compressor.
  - 5. Defective parts will be repaired or replaced during the warranty period at no charge.
- B. **Contractor shall also provide a separate service and maintenance agreement including:**
  - 1. One year (1) service agreement of all split systems units shall commence when Owner occupies building with Certificate of Occupancy Date
  - 2. Routine maintenance service beginning after COO with a three (3) month interval as maximum time period between calls
  - 3. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of four (4) filter replacements, minimum of one fan belt replacement (if required) and controls check-out, adjustments, and recalibration.
  - 4. Provide 24-hour emergency service on breakdowns and malfunctions. After each service call, submit copy of service call work order or report that includes description of work performed.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. LG Electronics
- B. Mitsubishi | Trane
- C. Daikin

#### 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. Refrigerant lines internal to units shall be factory cleaned, dried, pressurized and sealed, with all refrigerant lines insulated.
- B. Performance Requirements: See Drawings for additional requirements.
- C. Electrical Characteristics: As Indicated on Drawings
  - 1. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Section 26 0583.

#### 2.03 INDOOR UNITS FOR DUCTED SYSTEMS

- A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer.

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1. Air Flow Configuration: Horizontal.
2. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
- B. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.
  1. Motor: NEMA MG 1; 1750 rpm single speed, permanently lubricated, hinge mounted.
- C. Air Filters: 1 inch thick glass fiber disposable type arranged for easy replacement.
- D. 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.

## 2.04 INDOOR 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.
  1. Location: Ceiling or Wall Mount as Indicated.
  2. Cabinet: Galvanized steel.
    - a. Finish: White.
  3. Fan: Line-flow fan direct driven by a single motor.
- 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.

## 2.05 OUTDOOR UNITS

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
  1. Comply with AHRI 210/240.
  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.
- B. Compressor: Scroll, [ ] 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.
- D. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gage ports, thermometer well (in liquid line).
  1. Provide thermostatic expansion valves.
  2. Provide heat pump reversing valves.
- E. Operating Controls:
  1. Control by Building Management System with local room sensor & override to maintain room temperature setting.
- F. Mounting Pad: Precast concrete parking bumpers, minimum 4 inches square; minimum of two located under cabinet feet.

## 2.06 REFRIGERANT PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn Type L.
  1. Fittings: ASME B16.22 wrought copper.

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2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy.
- B. Pipe Supports and Anchors:
  1. Provide hangers and supports that comply with MSS SP-58.
    - a. 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 Inch: Malleable iron adjustable swivel, split ring.

## **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.
- C. Verify that proper fuel supply is available for connection.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
- B. Install in accordance with NFPA 90A and NFPA 90B.

### **3.03 PIPING INSTALLATION**

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner parallel to building structure.
- 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. Install refrigeration systems in accordance with ASHRAE Std 15.
- G. Provide pressure testing for refrigerant piping per manufacturer's recommendations.
- H. Pipe condensate drain from indoor unit to drain as indicated on Plumbing Drawings.
- I. Insulate all refrigerant system suction, liquid, hot-gas and discharge piping per insulation schedule, code requirements, and equipment manufacturer recommendations.
  1. Flexible Elastomeric Cellular Insulation, minimum **2.0 inch thick**.
- J. Pipe Hangers and Supports:
  1. Install in accordance with ASME B31.5.
  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.

### **3.04 SYSTEM START UP**

- A. Prepare and start equipment for owner accept. Adjust for proper operation.
- B. **Start-up to be performed by Manufacturer's authorized service technician or contractor personnel certified by manufacturer.**

### **3.05 CLOSE OUT ACTIVITIES**

- A. Demonstrate operation to Owner's maintenance personnel.
- B. Provide (4) hour training of equipment to Owner after building turnover around Certificate of Occupancy date, and an additional (2) hour training follow up training 6 months later.

**END OF SECTION 23 8126**

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## SECTION 26 0505 SELECTIVE DEMOLITION FOR ELECTRICAL

### PART 1 GENERAL

#### 2.01 SECTION INCLUDES

- A. Electrical demolition.

#### 2.02 RELATED REQUIREMENTS

- A. Section 01 7000 - Execution and Closeout Requirements: Additional requirements for alterations work.
- B. Section 02 8400 - Polychlorinate Biphenyl (PCB) Remediation: Removal of equipment and materials containing substances regulated under the Federal Toxic Substances Control Act (TSCA), including but not limited to those containing PCBs and mercury.

#### 2.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Sustainable Design Documentation: Submit certification of removal and appropriate disposal of abandoned cables containing lead stabilizers.

### PART 2 PRODUCTS

#### 3.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

### PART 3 EXECUTION

#### 4.01 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as indicated.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on casual field observation and existing record documents.
- D. Report discrepancies to Owner before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.

#### 4.02 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
  - 1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
  - 2. Make temporary connections to maintain service in areas adjacent to work area.
- E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
  - 1. Notify Owner before partially or completely disabling system.
  - 2. Notify local fire service.
  - 3. Make notifications at least 24 hours in advance.
  - 4. Make temporary connections to maintain service in areas adjacent to work area.

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- F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
  - 1. Notify Owner at least 24 hours before partially or completely disabling system.
  - 2. Notify telephone utility company at least 24 hours before partially or completely disabling system.
  - 3. Make temporary connections to maintain service in areas adjacent to work area.

#### **4.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK**

- A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
  - 1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
  - 2. PCB- and DEHP-containing lighting ballasts.
  - 3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- F. Disconnect and remove abandoned panelboards and distribution equipment.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- I. Repair adjacent construction and finishes damaged during demolition and extension work.
- J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

#### **4.04 CLEANING AND REPAIR**

- A. See Section 01 7419 - Construction Waste Management and Disposal for additional requirements.
- B. Clean and repair existing materials and equipment that remain or that are to be reused.
- C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace broken electrical parts.

**END OF SECTION 26 0505**

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**SECTION 26 0519**  
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Single conductor building wire.
- B. Nonmetallic-sheathed cable.
- C. Underground feeder and branch-circuit cable.
- D. Service entrance cable.
- E. Armored cable.
- F. Metal-clad cable.
- G. Power and control tray cable.
- H. Manufactured wiring systems.
- I. Wiring connectors.
- J. Electrical tape.
- K. Heat shrink tubing.
- L. Oxide inhibiting compound.
- M. Wire pulling lubricant.
- N. Cable ties.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 26 0505 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
- C. Section 26 0513 - Medium-Voltage Cables: Cables and terminations for systems 601 V through 35,000 V.
- D. Section 26 0519.13 - Undercarpet Electrical Power Cables: Flat conductor cable and fittings for undercarpet power distribution.
- E. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- F. Section 26 0536 - Cable Trays for Electrical Systems: Additional installation requirements for cables installed in cable tray systems.
- G. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 26 2100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conductors.
- I. Section 26 3100 - Photovoltaic Collectors: Additional wiring requirements for photovoltaic systems.
- J. Section 28 4600 - Fire Detection and Alarm: Fire alarm system conductors and cables.
- K. Section 31 2316 - Excavation.
- L. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
- M. Section 31 2323 - Fill: Bedding and backfilling.

**1.03 REFERENCE STANDARDS**

- A. 2019 California Electrical Code (CEC).
- B. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire.

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- C. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- D. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.
- E. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation.
- F. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers.
- G. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.
- H. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes.
- I. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation).
- J. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- K. NECA 120 - Standard For Installing Armored Cable (Type AC) And Metal-Clad Cable (Type MC).
- L. NECA 121 - Standard for Installing Nonmetallic-Sheathed Cable (Type NM-B) and Underground Feeder and Branch-Circuit Cable (Type UF).
- M. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
- N. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- O. UL 4 - Armored Cable.
- P. UL 44 - Thermoset-Insulated Wires and Cables.
- Q. UL 83 - Thermoplastic-Insulated Wires and Cables.
- R. UL 486A-486B - Wire Connectors.
- S. UL 486C - Splicing Wire Connectors.
- T. UL 486D - Sealed Wire Connector Systems.
- U. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables.
- V. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
- W. UL 719 - Nonmetallic-Sheathed Cables.
- X. UL 854 - Service-Entrance Cables.
- Y. UL 1277 - Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
- Z. UL 1569 - Metal-Clad Cables.

#### **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 with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
  - 3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

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- 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 6000 - Product Requirements, for additional provisions.
  - 2. Extra Manufactured Wiring Systems Cable Assemblies: One of each configuration, 6 feet length.

#### **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of CEC
- 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 CEC and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
  - 1. Exceptions:
    - a. Use manufactured wiring systems for branch circuits where concealed under raised floors.
    - 1) Exception: Provide single conductor building wire in raceway for circuit homerun from distribution box to panelboard.

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- b. Use power and control tray cable or metal-clad cable for installation in cable tray.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Armored 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.
    - f. For isolated ground circuits.
- F. Metal-clad cable is not permitted.
  - 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.

## 2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of CEC.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductor Material:
  - 1. Provide copper conductors except where aluminum conductors are specifically indicated. Substitution of aluminum conductors for copper is not permitted. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
  - 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.
  - 4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.
- H. Minimum Conductor Size: 12 AWG.
  - 1. Branch Circuits: 12 AWG.
    - a. Exceptions:

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- 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.
- I. Where conductor size is not indicated, size to comply with CEC but not less than applicable minimum size requirements specified.
- J. 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. 480Y/277 V, 3 Phase, 4 Wire System:
      - 1) Phase A: Brown.
      - 2) Phase B: Orange.
      - 3) Phase C: Yellow.
      - 4) Neutral/Grounded: Gray.
    - b. 208Y/120 V, 3 Phase, 4 Wire System:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
      - 4) Neutral/Grounded: White.
    - c. Equipment Ground, All Systems: Green.
    - d. Isolated Ground, All Systems: Green with yellow stripe.
    - e. Travelers for 3-Way and 4-Way Switching: Pink.
    - f. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with 2019 CEC and is approved by the authority having jurisdiction.

## 2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
  1. Copper Building Wire:
    - a. Cerro Wire LLC: [www.cerrowire.com](http://www.cerrowire.com).
    - b. Encore Wire Corporation: [www.encorewire.com/#sle](http://www.encorewire.com/#sle).
    - c. General Cable Technologies Corporation: [www.generalcable.com/#sle](http://www.generalcable.com/#sle).
    - d. Southwire Company: [www.southwire.com/#sle](http://www.southwire.com/#sle).
    - e. Substitutions: See Section 01 6000 - Product Requirements.
  2. Aluminum Building Wire (only where specifically indicated or permitted for substitution):
    - a. Encore Wire Corporation: [www.encorewire.com/#sle](http://www.encorewire.com/#sle).
    - b. Southwire Company: [www.southwire.com/#sle](http://www.southwire.com/#sle).
    - c. Stabiloy, a brand of General Cable Technologies Corporation: [www.stabiloy.com/#sle](http://www.stabiloy.com/#sle).
    - d. Substitutions: See Section 01 6000 - 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:

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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. Aluminum Building Wire (only where specifically indicated or permitted for substitution): Type XHHW-2.

#### **2.04 NONMETALLIC-SHEATHED CABLE**

- A. Manufacturers:
  1. Cerro Wire LLC: [www.cerrowire.com/#sle](http://www.cerrowire.com/#sle).
  2. Encore Wire Corporation: [www.encorewire.com/#sle](http://www.encorewire.com/#sle).
  3. Southwire Company: [www.southwire.com/#sle](http://www.southwire.com/#sle).
  4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: CEC, Type NM multiple-conductor cable listed and labeled as complying with UL 719, Type NM-B.
- C. Conductor Stranding:
  1. Size 10 AWG and Smaller: Solid.
  2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.

#### **2.05 UNDERGROUND FEEDER AND BRANCH-CIRCUIT CABLE**

- A. Manufacturers:
  1. Cerro Wire LLC: [www.cerrowire.com/#sle](http://www.cerrowire.com/#sle).
  2. Encore Wire Corporation: [www.encorewire.com/#sle](http://www.encorewire.com/#sle).
  3. Southwire Company: [www.southwire.com/#sle](http://www.southwire.com/#sle).
  4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: CEC, Type UF multiple-conductor cable listed and labeled as complying with UL 493, Type UF-B.
- C. Provide equipment grounding conductor unless otherwise indicated.
- D. Conductor Stranding:
  1. Size 10 AWG and Smaller: Solid.
  2. Size 8 AWG and Larger: Stranded.
- E. Insulation Voltage Rating: 600 V.
- F. Cable Jacket: Listed and labeled as sunlight resistant.

#### **2.06 SERVICE ENTRANCE CABLE**

- A. Manufacturers:
  1. Copper Service Entrance Cable:
    - a. Cerro Wire LLC: [www.cerrowire.com/#sle](http://www.cerrowire.com/#sle).
    - b. Encore Wire Corporation: [www.encorewire.com/#sle](http://www.encorewire.com/#sle).
    - c. Southwire Company: [www.southwire.com/#sle](http://www.southwire.com/#sle).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
  2. Aluminum Service Entrance Cable:
    - a. Encore Wire Corporation: [www.encorewire.com/#sle](http://www.encorewire.com/#sle).
    - b. General Cable Technologies Corporation
    - c. Sttabiloy
    - d. Southwire Company: [www.southwire.com/#sle](http://www.southwire.com/#sle).
- B. Service Entrance Cable for Underground Use: CEC, Type USE single-conductor cable listed and labeled as complying with UL 854, Type USE-2, and with UL 44 Type RHH/RHW-2.

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- C. Conductor Stranding: Stranded.
- D. Insulation Voltage Rating: 600 V.

## **2.07 ARMORED CABLE**

- A. Manufacturers:
  - 1. AFC Cable Systems Inc: [www.afcweb.com/#sle](http://www.afcweb.com/#sle).
  - 2. Encore Wire Corporation: [www.encorewire.com/#sle](http://www.encorewire.com/#sle).
  - 3. Southwire Company: [www.southwire.com/#sle](http://www.southwire.com/#sle).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: CEC, Type AC cable listed and labeled as complying with UL 4, 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.
- F. Grounding: Combination of interlocking armor and integral bonding wire.
  - 1. Provide additional full-size integral insulated equipment grounding conductor for redundant grounding, suitable for general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities.
- G. Armor: Steel, interlocked tape.

## **2.08 POWER AND CONTROL TRAY CABLE**

- A. Manufacturers:
  - 1. Encore Wire Corporation: [www.encorewire.com/#sle](http://www.encorewire.com/#sle).
  - 2. General Cable Technologies Corporation
  - 3. Okonite: [www.okonite.com/#sle](http://www.okonite.com/#sle).
  - 4. Southwire Company: [www.southwire.com/#sle](http://www.southwire.com/#sle).
  - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: CEC, 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 CEC.
- 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).

## **2.09 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 0526.
- C. Wiring Connectors for Splices and Taps:
  - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
  - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:

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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. Aluminum Conductors: Use compression connectors for all connections.
7. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
8. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
  1. Manufacturers:
    - a. 3M: [www.3m.com/#sle](http://www.3m.com/#sle).
    - b. Ideal Industries, Inc: [www.idealindustries.com/#sle](http://www.idealindustries.com/#sle).
    - c. NSI Industries LLC: [www.nsiindustries.com/#sle](http://www.nsiindustries.com/#sle).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- H. Push-in Wire Connectors: Rated 600 V, 221 degrees F.
  1. Manufacturers:
    - a. Ideal Industries, Inc: [www.idealindustries.com/#sle](http://www.idealindustries.com/#sle).
    - b. NSI Industries LLC: [www.nsiindustries.com/#sle](http://www.nsiindustries.com/#sle).
    - c. Wago Corporation: [www.wago.us/#sle](http://www.wago.us/#sle).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- I. Mechanical Connectors: Provide bolted type or set-screw type.
  1. Manufacturers:
  2.
    - a. Burndy LLC: [www.burndy.com/#sle](http://www.burndy.com/#sle).
    - b. Bundy, LLC
    - c. Ilsco: [www.ilsco.com/#sle](http://www.ilsco.com/#sle).
    - d. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
    - e. Substitutions: See Section 01 6000 - Product Requirements.
- J. Compression Connectors: Provide circumferential type or hex type crimp configuration.
  1. Manufacturers:
    - a. Burndy LLC: [www.burndy.com/#sle](http://www.burndy.com/#sle).
    - b. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
    - c. Substitutions: See Section 01 6000 - Product Requirements.
- K. 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](http://www.burndy.com/#sle).
    - b. Ilsco: [www.ilsco.com/#sle](http://www.ilsco.com/#sle).
    - c. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).

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d. Substitutions: See Section 01 6000 - Product Requirements.

## 2.10 WIRING ACCESSORIES

- A. Electrical Tape:
  - 1. Manufacturers:
    - a. 3M: [www.3m.com/#sle](http://www.3m.com/#sle).
    - b. Plymouth Rubber Europa: [www.plymouthrubber.com/#sle](http://www.plymouthrubber.com/#sle).
  - 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. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
  - 5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
  - 6. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
  - 7. 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](http://www.3m.com/#sle).
    - b. Burndy LLC: [www.burndy.com/#sle](http://www.burndy.com/#sle).
    - c. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
    - d. Substitutions: See Section 01 6000 - 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](http://www.burndy.com/#sle).
    - b. Ideal Industries, Inc: [www.idealindustries.com/#sle](http://www.idealindustries.com/#sle).
    - c. IlSCO: [www.ilsco.com/#sle](http://www.ilsco.com/#sle).
    - d. Substitutions: See Section 01 6000 - 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](http://www.3m.com/#sle).
    - b. American Polywater Corporation: [www.polywater.com/#sle](http://www.polywater.com/#sle).
    - c. Ideal Industries, Inc: [www.idealindustries.com/#sle](http://www.idealindustries.com/#sle).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- E. Cable Ties: Material and tensile strength rating suitable for application.
  - 1. Manufacturers:
    - a. Burndy LLC: [www.burndy.com/#sle](http://www.burndy.com/#sle).
    - b. Substitutions: See Section 01 6000 - Product Requirements.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that interior of building has been protected from weather.

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- 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 CEC.
- 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. Arrange circuiting to minimize splices.
  - 4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
  - 5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
  - 6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
  - 7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
  - 8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
  - 9. 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 armored cable (Type AC) 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. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- G. Secure and support conductors and cables in accordance with CEC 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.
- H. Terminate cables using suitable fittings.
  - 1. Armored Cable (Type AC):
    - a. Use listed fittings and anti-short, insulating bushings.

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- b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
  - c. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.
- 2. 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.
  - c. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.
- I. Install conductors with a minimum of 12 inches of slack at each outlet.
- J. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- L. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with CEC.
- M. Make wiring connections using specified wiring connectors.
  - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
  - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
  - 3. Do not remove conductor strands to facilitate insertion into connector.
  - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other 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.
- N. 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.
- O. Insulate ends of spare conductors using vinyl insulating electrical tape.
- P. 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.
- Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- R. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

### 3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. 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 26 0519

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## SECTION 26 0526 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. Chemically-enhanced ground electrodes.
- G. Ground plate electrodes.
- H. Ground enhancement material.
- I. Ground access wells.
- J. Pre-fabricated signal reference grids.

#### 1.02 RELATED REQUIREMENTS

- A. Section 09 6500 - Resilient Flooring: Static control flooring.
- B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
  - 1. Includes oxide inhibiting compound.
- C. Section 26 0536 - Cable Trays for Electrical Systems: Additional grounding and bonding requirements for cable tray systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 3100 - Photovoltaic Collectors: Additional grounding and bonding requirements for photovoltaic systems.
- F. Section 26 5600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.
- G. Section 33 7900 - Site Grounding.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical CODE (CEC).
- B. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- D. NEMA GR 1 - Ground Rod Electrodes and Ground Rod Electrode Couplings.
- E. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- F. NFPA 99 - Health Care Facilities Code.
- G. NFPA 780 - Standard for the Installation of Lightning Protection Systems.
- H. UL 467 - Grounding and Bonding Equipment.

#### 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.

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3. For signal reference grids, coordinate the work with access flooring furnished in accordance with Section 09 6900.
  4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install ground rod electrodes until final backfill and compaction is complete.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittals 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. Conform to requirements of CEC.
- 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 CEC 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 CEC 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.

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2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
  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 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.
  6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
  7. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in CEC. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
    - a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
    - b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
    - c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
  8. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in CEC.
- G. Service-Supplied System Grounding:

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1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
  2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- H. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
1. Provide grounding electrode system for each separate building or structure.
  2. Provide equipment grounding conductor routed with supply conductors.
  3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
  4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.
- I. Separately Derived System Grounding:
1. Separately derived systems include, but are not limited to:
    - a. Transformers (except autotransformers such as buck-boost transformers).
    - 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.
- J. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
  2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
  3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
  4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
  5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.

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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 CEC. 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.
  12. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with CEC and NFPA 99.
- K. 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.
- L. 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 2 by 12 inches unless otherwise indicated or required.
    - d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

## 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 0526:
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).
  2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gage of specified conductors.
- 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.

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2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
    - a. Exceptions:
      - 1) Use mechanical connectors for connections to electrodes at ground access wells.
  3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
    - a. Exceptions:
      - 1) Use exothermic welded connections for connections to metal building frame.
  4. Manufacturers - Mechanical and Compression Connectors:
    - a. Advanced Lightning Technology (ALT): [www.altfab.com/#sle](http://www.altfab.com/#sle).
    - b. Burndy LLC: [www.burndy.com/#sle](http://www.burndy.com/#sle).
    - c. Harger Lightning & Grounding: [www.harger.com/#sle](http://www.harger.com/#sle).
    - d. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
    - e. Substitutions: See Section 01 6000 - Product Requirements.
  5. Manufacturers - Exothermic Welded Connections:
    - a. Burndy LLC: [www.burndy.com/#sle](http://www.burndy.com/#sle).
    - b. Cadweld, a brand of Erico International Corporation: [www.erico.com/#sle](http://www.erico.com/#sle).
    - c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: [www.thermoweld.com/#sle](http://www.thermoweld.com/#sle).
- 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.
- 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](http://www.altfab.com/#sle).
    - b. Erico International Corporation: [www.erico.com/#sle](http://www.erico.com/#sle).
    - c. Galvan Industries, Inc: [www.galvanelectrical.com/#sle](http://www.galvanelectrical.com/#sle).
    - d. Harger Lightning & Grounding: [www.harger.com/#sle](http://www.harger.com/#sle).
    - e. Substitutions: See Section 01 6000 - Product Requirements.
- F. Ground Enhancement Material:
1. Description: Factory-mixed conductive material designed for permanent and maintenance-free improvement of grounding effectiveness by lowering resistivity.
- G. 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.
  2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
  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".

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.

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- 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 (750mm) deep in accordance with 2019 CEC 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 0553.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.
- 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 26 0526**

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## SECTION 26 0529 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 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 05 5000 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- C. Section 26 0533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- D. Section 26 0536 - Cable Trays for Electrical Systems: Additional support and attachment requirements for cable tray.
- E. Section 26 0533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- F. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
- G. Section 26 2513 - Low-Voltage Busways: Additional support and attachment requirements for busway.
- H. Section 26 3100 - Photovoltaic Collectors: Photovoltaic module mounting systems.
- I. Section 26 5100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- J. Section 26 5133 - Luminaires, Ballasts, and Drivers - Lutron: Additional support and attachment requirements for luminaires.
- K. Section 26 5600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- D. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- E. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- G. MFMA-4 - Metal Framing Standards Publication.
- H. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- I. NFPA 101 - Life Safety Code.
- J. UL 5B - Strut-Type Channel Raceways and Fittings.

#### 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.

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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 the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for 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 CEC.
- B. Comply with applicable building code.
- C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- D. Installer Qualifications for Field-Welding: As specified in Section 05 5000.
- 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 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.

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4. Do not use products for applications other than as permitted by CEC 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.
  - 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 0548.
- C. Materials for Metal Fabricated Supports: Comply with Section 05 5000.
- D. 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](http://www.cooperindustries.com/#sle).
    - b. Erico International Corporation: [www.erico.com/#sle](http://www.erico.com/#sle).
    - c. O-Z/Gedney, a brand of Emerson Electric Co: [www.emerson.com/#sle](http://www.emerson.com/#sle).
    - d. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
    - e. Substitutions: See Section 01 6000 - Product Requirements.
- E. 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](http://www.cooperindustries.com/#sle).
    - b. Erico International Corporation: [www.erico.com/#sle](http://www.erico.com/#sle).
    - c. O-Z/Gedney, a brand of Emerson Electric Co: [www.emerson.com/#sle](http://www.emerson.com/#sle).
    - d. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
    - e. Substitutions: See Section 01 6000 - Product Requirements.
- F. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
  1. Comply with MFMA-4.
  2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
  3. Channel Material:
    - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
    - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
  4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
  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](http://www.cooperindustries.com/#sle).
    - b. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
    - c. Unistrut, a brand of Atkore International Inc: [www.unistrut.com/#sle](http://www.unistrut.com/#sle).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
    - e. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

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- G. Fiberglass Channel (Strut) Framing Systems: Factory-fabricated continuous-slot fiberglass channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Channel Material: Use polyester resin or vinyl ester resin.
  2. Minimum Channel Dimensions: 1-5/8 inch width by 1 inch height.
  3. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.
  4. Manufacturers:
    - a. Enduro Composites: [www.endurocomposites.com/#sle](http://www.endurocomposites.com/#sle).
    - b. Substitutions: See Section 01 6000 - Product Requirements.
    - c. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
- H. 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.
- I. 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](http://www.cooperindustries.com/#sle).
    - b. Erico International Corporation: [www.erico.com/#sle](http://www.erico.com/#sle).
    - c. PHP Systems/Design: [www.phpsd.com/#sle](http://www.phpsd.com/#sle).
    - d. Unistrut, a brand of Atkore International Inc: [www.unistrut.com/#sle](http://www.unistrut.com/#sle).
    - e. Substitutions: See Section 01 6000 - Product Requirements.
- J. 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.
  12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.

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- a. Comply with MFMA-4.
- b. Channel Material: Use galvanized steel.
- c. 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](http://www.us.hilti.com/#sle).
  - b. ITW Red Head, a division of Illinois Tool Works, Inc: [www.itwredhead.com/#sle](http://www.itwredhead.com/#sle).
  - c. Powers Fasteners, Inc: [www.powers.com/#sle](http://www.powers.com/#sle).
  - d. Simpson Strong-Tie Company Inc: [www.strongtie.com/#sle](http://www.strongtie.com/#sle).

### **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. 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 0548.
- I. Equipment Support and Attachment:
  - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
  - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
  - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
  - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- J. Conduit Support and Attachment: Also comply with Section 26 0533.13.
- K. Cable Tray Support and Attachment: Also comply with Section 26 0536.
- L. Box Support and Attachment: Also comply with Section 26 0533.16.
- M. Busway Support and Attachment: Also comply with Section 26 2513.
- N. Interior Luminaire Support and Attachment: Also comply with Section 26 5100.
- O. Exterior Luminaire Support and Attachment: Also comply with Section 26 5600.
- P. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

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- 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 4000 - Quality Requirements, for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION 26 0529**

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## SECTION 26 0533.13 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 3000 - Cast-in-Place Concrete: Concrete encasement of conduits.
- B. Section 07 8400 - Firestopping.
- C. Section 26 0519 - 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 0526 - Grounding and Bonding for Electrical Systems.
  - 1. Includes additional requirements for fittings for grounding and bonding.
- E. Section 26 0529 - Hangers and Supports for Electrical Systems.
- F. Section 26 0533.16 - Boxes for Electrical Systems.
- G. Section 26 0533.23 - Surface Raceways for Electrical Systems.
- H. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
- I. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- J. Section 26 2100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
- K. Section 27 1000 - Structured Cabling: Additional requirements for communications systems conduits.
- L. Section 31 2316 - Excavation.
- M. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
- N. Section 31 2323 - Fill: Bedding and backfilling.
- O. Section 33 7119 - Electrical Underground Ducts, Ductbanks, and Manholes.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).

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- C. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S).
- D. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A).
- E. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- G. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT).
- H. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC).
- I. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
- J. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit.
- K. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit.
- L. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
- M. NEMA TC 13 - Electrical Nonmetallic Tubing (ENT).
- N. UL 1 - Flexible Metal Conduit.
- O. UL 6 - Electrical Rigid Metal Conduit-Steel.
- P. UL 360 - Liquid-Tight Flexible Metal Conduit.
- Q. UL 514B - Conduit, Tubing, and Cable Fittings.
- R. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
- S. UL 797 - Electrical Metallic Tubing-Steel.
- T. UL 1242 - Electrical Intermediate Metal Conduit-Steel.

#### **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 the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittals 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.

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## 1.06 QUALITY ASSURANCE

- A. Conform to requirements of CEC.
- 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 CEC 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 galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
  - 2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit, 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 galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), 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 galvanized steel rigid metal conduit elbows for bends.
  - 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 PVC-coated galvanized steel rigid metal conduit.
  - 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 galvanized steel rigid metal conduit, intermediate metal conduit (IMC), 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 galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
  - 3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).

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4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.
- E. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT). Do not use MC cable in walls or ceilings except for the final connection to lighting fixtures, and less than 6' lengths.
- F. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.
- H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- I. 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.
- J. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.
- K. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

## 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 2100.
- C. Communications Systems Conduits: Also comply with Section 27 1000.
- D. Fittings for Grounding and Bonding: Also comply with Section 26 0526.
- 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 Circuit Homeruns: 3/4 inch (21 mm) trade size.
  2. Underground, Interior: 3/4 inch (21 mm) trade size.
  3. Underground, Exterior: 1 inch (27 mm) trade size.
- H. Where conduit size is not indicated, size to comply with CEC but not less than applicable minimum size requirements specified.

## 2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
  1. Allied Tube & Conduit: [www.alliedeg.com/#sle](http://www.alliedeg.com/#sle).
  2. Republic Conduit: [www.republic-conduit.com/#sle](http://www.republic-conduit.com/#sle).
  3. Wheatland Tube, a Division of Zekelman Industries [www.wheatland.com/#sle](http://www.wheatland.com/#sle).
  4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: CEC, 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](http://www.bptfittings.com/#sle).
    - b. O-Z/Gedney, a brand of Emerson Electric Co: [www.emerson.com/#sle](http://www.emerson.com/#sle).
    - c. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
    - d. Substitutions: See Section 01 6000 - Product Requirements.

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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 or malleable iron.
  - 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: [www.alliedeg.com/#sle](http://www.alliedeg.com/#sle).
  2. Republic Conduit: [www.republic-conduit.com/#sle](http://www.republic-conduit.com/#sle).
  3. Wheatland Tube, a Division of Zekelman Industries: [www.wheatland.com/#sle](http://www.wheatland.com/#sle).
  4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: CEC, 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](http://www.bptfittings.com/#sle).
    - b. O-Z/Gedney, a brand of Emerson Electric Co: [www.emerson.com/#sle](http://www.emerson.com/#sle).
    - c. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
    - d. Substitutions: See Section 01 6000 - 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 [www.alliedeg.com/#sle](http://www.alliedeg.com/#sle).
  2. Republic Conduit: [www.republic-conduit.com/#sle](http://www.republic-conduit.com/#sle).
  3. Wheatland Tube, a Division of Zekelman Industries: [www.wheatland.com/#sle](http://www.wheatland.com/#sle).
  4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: CEC, 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](http://www.bptfittings.com/#sle).
    - b. O-Z/Gedney, a brand of Emerson Electric Co: [www.emerson.com/#sle](http://www.emerson.com/#sle).
    - c. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
  2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  3. Material: Use steel or malleable iron.
  4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

#### **2.06 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)**

- A. Manufacturers:

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1. Thomas & Betts Corporation [www.tnb.com/#sle](http://www.tnb.com/#sle).
  2. Robroy Industries [www.robroy.com/#sle](http://www.robroy.com/#sle).
  3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: CEC, 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. Material: Use steel or malleable iron.
  4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 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](http://www.afcweb.com/#sle).
  2. Electri-Flex Company [www.electriflex.com/#sle](http://www.electriflex.com/#sle).
  3. International Metal Hose: [www.metalhose.com/#sle](http://www.metalhose.com/#sle).
  4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: CEC, 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](http://www.bptfittings.com/#sle).
    - b. O-Z/Gedney, a brand of Emerson Electric Co [www.emerson.com/#sle](http://www.emerson.com/#sle).
    - c. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
  2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  3. Material: Use steel or malleable iron.

## 2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
1. AFC Cable Systems, Inc: [www.afcweb.com/#sle](http://www.afcweb.com/#sle).
  2. Electri-Flex Company: [www.electriflex.com/#sle](http://www.electriflex.com/#sle).
  3. International Metal Hose: [www.metalhose.com/#sle](http://www.metalhose.com/#sle).
  4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: CEC, 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](http://www.bptfittings.com/#sle).
    - b. O-Z/Gedney, a brand of Emerson Electric Co: [www.emerson.com/#sle](http://www.emerson.com/#sle).
    - c. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
  2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  3. Material: Use steel or malleable iron.

## 2.09 ELECTRICAL METALLIC TUBING (EMT)

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- A. Manufacturers:
  - 1. Allied Tube & Conduit [www.alliedeg.com/#sle](http://www.alliedeg.com/#sle).
  - 2. Republic Conduit [www.republic-conduit.com/#sle](http://www.republic-conduit.com/#sle).
  - 3. Wheatland Tube, a Division of Zekelman Industries: [www.wheatland.com/#sle](http://www.wheatland.com/#sle).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: CEC, 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](http://www.bptfittings.com/#sle).
    - b. O-Z/Gedney, a brand of Emerson Electric Co: [www.emerson.com/#sle](http://www.emerson.com/#sle).
    - c. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
  - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 3. Material: Use steel or malleable iron.
    - 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.
    - b. Do not use set-screw type connectors and couplings.
  - 5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.
  - 6. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

## **2.10 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT**

- A. Manufacturers:
  - 1. Cantex Inc: [www.cantexinc.com/#sle](http://www.cantexinc.com/#sle).
  - 2. Carlon, a brand of Thomas & Betts Corporation: [www.carlon.com/#sle](http://www.carlon.com/#sle).
  - 3. JM Eagle [www.jmeagle.com/#sle](http://www.jmeagle.com/#sle).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: CEC, 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 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)**

- A. Description: CEC, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).
- B. Supports: Per manufacturer's recommendations.
- C. Fittings: Same type and manufacturer as conduit to be connected.

## **2.12 ACCESSORIES**

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.
- 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.

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- 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. 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](http://www.apsonline.com/#sle).
    - b. Substitutions: See Section 01 6000 - Product Requirements.
- I. 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](http://www.apsonline.com/#sle).
    - b. Substitutions: See Section 01 6000 - 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).
- 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. 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.

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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.
- I. Conduit Support:
1. Secure and support conduits in accordance with CEC and Section 26 0529 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 0548.
  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.
  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.
    - a. For securing conduits to studs in hollow stud walls.
    - b. For suspending conduits supported by spring steel conduit clips (only where specifically indicated or permitted).
  12. Where conduit support intervals specified in CEC and NECA standards differ, comply with the most stringent requirements.
- J. 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.

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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.
- K. 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 8400.
- L. Underground Installation:
1. Provide trenching and backfilling in accordance with Section 31 2316.13.
  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 0553 along entire conduit length for service entrance where not concrete-encased.
- M. 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.
- N. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 03 3000 with minimum concrete cover of 3 inches on all sides unless otherwise indicated.
- O. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with CEC.
- P. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
  2. Where calculated in accordance with CEC for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.

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3. Where calculated in accordance with CEC 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.
- Q. 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.
- R. 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.
- S. Provide grounding and bonding in accordance with Section 26 0526.
- T. Identify conduits in accordance with Section 26 0553.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. 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 26 0533.13**

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## SECTION 26 0533.16 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.

#### 1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 07 8400 - Firestopping.
- C. Section 08 3100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- D. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- E. Section 26 0529 - Hangers and Supports for Electrical Systems.
- F. Section 26 0533.13 - 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.
- G. Section 26 0533.23 - Surface Raceways for Electrical Systems:
  - 1. Accessory boxes designed specifically for surface raceway systems.
  - 2. Lay-in wireways and wiring troughs with removable covers.
- H. Section 26 0539 - Underfloor Raceways for Electrical Systems: Junction boxes for underfloor duct systems.
- I. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
- J. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- K. Section 26 2726 - Wiring Devices:
  - 1. Wall plates.
  - 2. Floor box service fittings.
  - 3. Poke-through assemblies.
  - 4. Access floor boxes.
  - 5. Additional requirements for locating boxes for wiring devices.
- L. Section 26 2813 - Fuses: Spare fuse cabinets.
- M. Section 27 1000 - Structured Cabling: Additional requirements for communications systems outlet boxes.
- N. Section 33 7119 - Electrical Underground Ducts, Ductbanks, and Manholes: Concrete manholes for electrical systems.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC)
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- C. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

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- D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
- E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- F. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- H. SCTE 77 - Specifications for Underground Enclosure Integrity.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- J. UL 508A - Industrial Control Panels.
- K. UL 514A - Metallic Outlet Boxes.
- L. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.

#### **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 the contract documents. Obtain direction before proceeding with work.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for 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 6000 - Product Requirements, for additional provisions.
  - 2. Keys for Lockable Enclosures: Two of each different key.

#### **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of CEC.

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- 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 CEC 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 CEC 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 1000.
  - 17. Wall Plates: Comply with Section 26 2726.
  - 18. Manufacturers:

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- 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.
  - f. Substitutions: See Section 01 6000 - 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 6000 - 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. Substitutions: See Section 01 6000 - 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 6000 - Product Requirements.
- F. Floor Boxes:
  1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 2726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
  2. Use cast iron floor boxes within slab on grade.
  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.

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**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.
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](http://www.hubbellpowersystems.com/#sle).
    - 2) MacLean Highline: [www.macleanhighline.com/#sle](http://www.macleanhighline.com/#sle).
    - 3) Oldcastle Precast, Inc: [www.oldcastleprecast.com/#sle](http://www.oldcastleprecast.com/#sle).
    - 4) Substitutions: See Section 01 6000 - 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.
      - (a) 11 by 18 by 12 inches nominal; Model PHA111812 (stackable).
    - 2) MacLean Highline CHA Series: Fiberglass/polymer concrete splice box/pull box; available Tier 8 and Tier 15 load ratings.
      - (a) 11 by 18 by 12 inches nominal; Model CHA111812.
    - 3) MacLean Highline CVA Series: Fiberglass/polymer concrete splice vault; available Tier 8, Tier 15, and Tier 22 load ratings.
      - (a) 30 by 48 by 18 inches nominal; Model CVA304818.

## **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 CEC
- 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.

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#### H. Box Locations:

1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 3100 as required where approved by the Architect.
2. Unless dimensioned, box locations indicated are approximate.
3. Locate boxes as required for devices installed under other sections or by others.
  - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.
  - b. Communications Systems Outlets: Comply with Section 27 1000.
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 0533.13.
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 CEC and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide required seismic controls in accordance with Section 26 0548.
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 CEC.. 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 3000.
- 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 3000, 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 8400.
- 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 0526.
- V. Identify boxes in accordance with Section 26 0553.

### **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 26 0533.16**

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## SECTION 26 0533.23 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 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
  - 1. Includes metal channel (strut) used as raceway.
- C. Section 26 0533.13 - Conduit for Electrical Systems.
- D. Section 26 0533.16 - Boxes for Electrical Systems.
- E. Section 26 0539 - Underfloor Raceways for Electrical Systems: Trench duct.
- F. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- G. Section 26 2723 - Indoor Service Poles.
- H. Section 26 2726 - Wiring Devices: Receptacles.
- I. Section 27 1000 - Structured Cabling: Voice and data jacks.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. NEMA PRP 5 - Installation Guidelines for Surface Nonmetallic Raceway.
- E. UL 5 - Surface Metal Raceways and Fittings.
- F. UL 5A - Nonmetallic Surface Raceways and Fittings.
- G. UL 111 - Outline of Investigation for Multioutlet Assemblies.
- H. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings.

#### 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 0533.16 and conduit provided under Section 26 0533.13 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. Notify Architect of any conflicts with or deviations from the 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

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- A. See Section 01 3000 - Administrative Requirements, for 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. Conform to requirements of CEC.
- 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 CEC and product listing.

#### **2.02 SURFACE RACEWAY SYSTEMS**

- A. Manufacturers:
  - 1. Hubbell Incorporated: [www.hubbell.com/#sle](http://www.hubbell.com/#sle).
  - 2. MonoSystems, Inc: [www.monosystems.com/#sle](http://www.monosystems.com/#sle).
  - 3. Wiremold, a brand of Legrand North America, Inc: [www.legrand.us/#sle](http://www.legrand.us/#sle).
  - 4. Substitutions: See Section 01 6000 - 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 0529.
- F. Surface Raceway System:
  - 1. Raceway Type: Single channel, painted steel.
  - 2. Length: As indicated on the drawings.

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3. Color: To be selected by Architect.
4. Accessory Device Boxes: Suitable for the devices to be installed; color to match raceway.
5. Integrated Device Provisions:
  - a. Receptacles:
    - 1) Comply with Section 26 2726, except for finishes.
    - 2) Configuration: As indicated on the drawings.
    - 3) Color: Match raceway.
    - 4) Spacing: As indicated on the drawings.
  - b. Communications Outlets:
    - 1) Voice and Data Jacks: As specified in Section 27 1000.
    - 2) Voice and Data Jacks: Include provisions for jacks furnished by others.
    - 3) Configuration: As indicated on the drawings.
    - 4) Spacing: As indicated on the drawings.
6. Products:
  - a. Hubbell Incorporated: [www.hubbell.com/#sle](http://www.hubbell.com/#sle).
  - b. Substitutions: See Section 01 6000 - Product Requirements.

### 2.03 WIREWAYS

- A. Manufacturers:
  1. Cooper B-Line, a division of Cooper Industries: [www.cooperindustries.com/#sle](http://www.cooperindustries.com/#sle).
  2. Enduro Composites: [www.endurocomposites.com/#sle](http://www.endurocomposites.com/#sle).
  3. Hoffman, a brand of Pentair Technical Products: [www.hoffmanonline.com/#sle](http://www.hoffmanonline.com/#sle).
  4. Schneider Electric; Square D Products: [www.schneider-electric.us/#sle](http://www.schneider-electric.us/#sle).
  5. Substitutions: See Section 01 6000 - 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 CEC but not less than applicable minimum size requirements specified.

### 2.04 WALL DUCT

- A. Manufacturers:
  1. Dennis Filges Company, Inc: [www.filgesco.com/#sle](http://www.filgesco.com/#sle).
  2. Hubbell Incorporated: [www.hubbell.com/#sle](http://www.hubbell.com/#sle).
  3. Schneider Electric; Square D Products: [www.schneider-electric.us/#sle](http://www.schneider-electric.us/#sle).
  4. Wiremold, a brand of Legrand North America, Inc: [www.legrand.us/#sle](http://www.legrand.us/#sle).
  5. Substitutions: See Section 01 6000 - Product Requirements.
  6. Source Limitations: Where the wall duct system includes connections to trench duct as specified in Section 26 0539, 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

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- A. See Section 01 4000 - Quality Requirements, for 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 CEC 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. Install raceways plumb and level.
- D. Arrange wireways and associated raceway connections to comply with CEC, including but not limited to requirements for deflected conductors and wireways used as pullboxes. Increase size of wireway where necessary.
- E. Secure and support raceways in accordance with Section 26 0529 at intervals complying with CEC and manufacturer's requirements.
- F. Close unused raceway openings.
- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Identify raceways in accordance with Section 26 0553.

#### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for 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 26 0533.23**

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## SECTION 26 0548 VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Seismic control requirements.
  - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- C. Vibration-isolated equipment support bases.
- D. Vibration isolators.
- E. External seismic snubber assemblies.
- F. Seismic restraint systems.

#### 1.02 RELATED REQUIREMENTS

- A. Section 01 4533 - Code-Required Special Inspections and Procedures.
- B. Section 03 3000 - Cast-in-Place Concrete.
- C. Section 05 5000 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- D. Section 26 0529 - Hangers and Supports for Electrical Systems.

#### 1.03 DEFINITIONS

- A. Electrical Component: Where referenced in this section in regards to seismic controls, applies to any portion of the electrical system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g. conduit, cable tray).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

#### 1.04 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC)
- B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- C. ASCE 19 - Structural Applications of Steel Cables for Buildings.
- D. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications.
- E. 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.
- F. FEMA 413 - Installing Seismic Restraints for Electrical Equipment.
- G. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage.
- H. ICC (IBC) - International Building Code.
- I. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components.
- J. MFMA-4 - Metal Framing Standards Publication.
- K. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- L. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems.

#### 1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.

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3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  4. Seismic Controls:
    - a. Coordinate the arrangement of seismic restraints with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
    - b. Coordinate the work with other trades to accommodate relative positioning of essential and non-essential components in consideration of seismic interaction.
  5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

#### 1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- C. 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 method for spring element load capacities.
  2. Seismic Controls: Include seismic load capacities.
- D. 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.
- E. Shop Drawings - Seismic Controls:
  1. Include dimensioned plan views and sections indicating proposed electrical component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
  2. Identify mounting conditions required for equipment seismic qualification.
  3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
  4. Indicate proposed arrangement of distributed system trapeze support groupings.
  5. Indicate proposed locations for distributed system flexible fittings and/or connections.
  6. Indicate locations of seismic separations where applicable.
  7. Include point load drawings indicating design loads transmitted to structure at each attachment location.
- F. Seismic Design Data:
  1. Compile information on project-specific characteristics of actual installed electrical components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
    - a. Component operating weight and center of gravity.
    - b. Component elevation in the building in relation to the roof elevation (z/h).
    - c. Component importance factor (Ip).
    - d. For distributed systems, component materials and connection methods.
    - e. Component amplification factor (ap) and component response modification factor (Rp), determined in accordance with ASCE 7 tables.
    - f. Applicability of overstrength factor (for certain anchorage in concrete and masonry).
  2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.

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- G. Certification for seismically qualified equipment; identify basis for certification.
- H. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.
- I. 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.
- J. Evidence of qualifications for seismic controls designer.
- K. Evidence of qualifications for manufacturer.
- L. Manufacturer's detailed field testing and inspection procedures.
- M. Field quality control test reports.

#### **1.07 QUALITY ASSURANCE**

- A. Comply with CEC.
- B. Comply with applicable building code.
- C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- D. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.
  - 1. Designer may be employed by the manufacturer of the seismic restraint products.
- E. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

### **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 electrical equipment and/or electrical 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 seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
  - 4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
  - 5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2 inch operating clearance beneath base unless otherwise indicated.
- D. Equipment Isolation:
  - 1. Transformers:
    - a. Specified vibration isolators are in addition to any factory-installed internal core and coil assembly vibration isolators unless otherwise indicated.
    - b. Floor-Mounted Transformers, Non-Seismic Applications: Use resilient material isolator pads, resilient material isolator mounts, or open (unhoused) spring isolators.
    - c. Floor-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts or seismic type restrained spring isolators.

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- d. Suspended Transformers, Non-Seismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
- e. Suspended Transformers, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
- f. Wall-Mounted Transformers, Non-Seismic Applications: Use resilient material isolator mounts.
- g. Wall-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts.
- h. Minimum Static Deflection:
  - 1) Transformers Mounted on Grade-Level Slabs: 0.25 inch deflection unless otherwise indicated.
  - 2) Transformers Mounted at Above-Grade Levels: 0.5 inch deflection unless otherwise indicated.
- 2. Engine Generators:
  - a. Specified vibration isolators are in addition to any factory-installed internal vibration isolators between generator set and integral base unless otherwise indicated; obtain generator set manufacturer approval of applied vibration isolation.
  - b. Non-Seismic Applications, Isolators Not Located Below Sub-Base Fuel Tank: Use housed spring isolators or restrained spring isolators.
  - c. Non-Seismic Applications, Isolators Located Below Sub-Base Fuel Tank: Use restrained spring isolators.
  - d. Seismic Applications: Use seismic type restrained spring isolators.
  - e. Provide vibration-isolated concrete inertia bases where indicated.
  - f. Minimum Static Deflection:
    - 1) Generators Mounted on Grade-Level Slabs: 1 inch deflection unless otherwise indicated.
    - 2) Generators Mounted at Above-Grade Levels: 2 inch deflection unless otherwise indicated.
- E. Conduit Isolation:
  - 1. Use flexible conduit or cable for electrical connections to vibration-isolated equipment, including equipment installed under other sections or by others.
    - a. Minimum Length: 3 feet unless otherwise indicated.
  - 2. Vibration Isolators:
    - a. Provide vibration isolators for conduit supports:
      - 1) Located within 50 feet of connected vibration-isolated equipment where flexible connection to equipment is not possible.
      - 2) For conduits over 2 inch trade size located below or within 50 feet of noise-sensitive areas indicated.
    - b. Minimum Static Deflection:
      - 1) First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
      - 2) Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
    - c. Suspended Conduits, Non-Seismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
    - d. Suspended Conduits, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
    - e. Use modular seal or approved resilient material where vibration-isolated conduits penetrate building elements (e.g. walls, floors) arranged to prevent vibration transmission to structure.

## 2.02 SEISMIC CONTROL REQUIREMENTS

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- A. Design and provide electrical component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor electrical components.
- B. Seismic Design Criteria: As indicated on drawings.
- C. Seismic Qualification of Equipment:
  - 1. Provide special certification for electrical equipment furnished under other sections and assigned a component importance factor ( $I_p$ ) of 1.5, certifying that equipment will remain operable following a design level earthquake.
  - 2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
  - 3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
  - 4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.
- D. Premanufactured Modular Electrical Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.
- E. Seismic Restraints:
  - 1. Provide seismic restraints for electrical components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
  - 2. Seismic Restraint Exemptions:
    - a. Exemptions for Seismic Design Category C:
      - 1) Electrical components where either of the following apply:
        - (a) The component importance factor ( $I_p$ ) is 1.0 and the component is positively attached to the structure.
        - (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
    - b. Exemptions for Seismic Design Category D, E, and F:
      - 1) Discrete electrical components that are positively attached to the structure where either of the following apply:
        - (a) The component weighs 400 pounds or less, has a center of mass located 4 feet or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the component importance factor ( $I_p$ ) is 1.0.
        - (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
    - c. Conduit, Cable Tray, and Raceway Exemptions, All Seismic Design Categories:
      - 1) Raceways with component importance factor ( $I_p$ ) of 1.0 where flexible connections are provided between cable tray or raceway and associated components, where cable tray or raceway is positively attached to the structure, and where one of the following apply:
        - (a) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
        - (b) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 200 pounds or less.

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- (c) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
    - (d) Hanger supported conduits, cable trays, or raceways with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single rod is 50 pounds or less.
  - 2) Conduits less than 2-1/2 inch trade size.
- d. Lighting Exemptions, All Seismic Design Categories:
  - 1) Suspended luminaires where attachments are designed to accommodate 1.4 times the operating weight acting in both the vertical and horizontal directions and connections to structure allow for 360 degree range of motion in the horizontal plane; arrange to prevent impact between luminaires and the structure or other nonstructural components.
  - 2) Lay-in luminaires weighing less than 56 pounds secured to ceiling grid and provided with safety wires in accordance with ASTM E580/E580M.
- 3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
  - a. ASHRAE (HVACA).
  - b. FEMA 413.
  - c. FEMA E-74.
  - d. SMACNA (SRM).
- 4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third party registered professional engineer acceptable to authorities having jurisdiction.
- 5. Seismic Type Vibration Isolators:
  - a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
- 6. External Seismic Snubber Assemblies:
  - a. Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
  - b. Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.
- 7. Seismic Restraint Systems:
  - a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
  - b. Use only cable restraints to restrain vibration-isolated electrical components, including distributed systems.
  - c. Use only one restraint system type for a given electrical component or distributed system (e.g. conduit, cable tray) run; mixing of cable and rigid restraints on a given component/run is not permitted.
  - d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain electrical component in all lateral directions; consider bracket geometry in anchor load calculations.
  - e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported electrical component weight.
  - f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported electrical component weight.
  - g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.

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- h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
- i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
- j. Manufacturer's certified seismic restraint design may be submitted as an alternative to project-specific design and documentation, subject to approval of authorities having jurisdiction.

**F. Seismic Attachments:**

- 1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
- 2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
- 3. Do not use power-actuated fasteners.
- 4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
- 5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
- 6. Concrete Housekeeping Pads:
  - a. Increase size of pad as required to comply with anchor requirements.
  - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

**G. Seismic Interactions:**

- 1. Include provisions to prevent seismic impact between electrical components and other structural or nonstructural components.
- 2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
- 3. Comply with minimum clearance requirements between electrical equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.

**H. Seismic Relative Displacement Provisions:**

- 1. Use suitable fittings or flexible connections to accommodate:
  - a. Relative displacements at connections between components, including distributed systems (e.g. conduit, cable tray); do not exceed load limits for equipment utility connections.
  - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
  - c. Design displacements at seismic separations.
  - d. Anticipated drifts between floors.

## **2.03 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES**

**A. Manufacturers:**

- 1. Vibration-Isolated Equipment Support Bases:
  - a. Kinetics Noise Control, Inc: [www.kineticsnoise.com/#sle](http://www.kineticsnoise.com/#sle).
  - b. Mason Industries: [www.mason-ind.com/#sle](http://www.mason-ind.com/#sle).
  - c. Vibration Eliminator Company, Inc: [www.veco-nyc.com/#sle](http://www.veco-nyc.com/#sle).
- 2. Substitutions: See Section 01 6000 - Product Requirements.
- 3. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

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- B. Vibration-Isolated Structural Steel Bases:
  - 1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
- C. 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 in accordance with Section 03 3000.

## 2.04 VIBRATION ISOLATORS

- A. Manufacturers:
  - 1. Vibration Isolators:
    - a. Kinetics Noise Control, Inc: [www.kineticsnoise.com/#sle](http://www.kineticsnoise.com/#sle).
    - b. Mason Industries: [www.mason-ind.com/#sle](http://www.mason-ind.com/#sle).
    - c. Vibration Eliminator Company, Inc: [www.veco-nyc.com/#sle](http://www.veco-nyc.com/#sle).
  - 2. Substitutions: See Section 01 6000 - Product Requirements.
  - 3. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.
- B. 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.
  - 3. Seismic Snubbing Elements for Seismic Isolators:
    - a. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
    - b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.
- C. Vibration Isolators for Non-Seismic Applications:
  - 1. Resilient Material Isolator Pads:
    - a. Description: Single or multiple layer pads utilizing elastomeric (e.g. neoprene, rubber) or fiberglass isolator material.
    - b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
    - c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
  - 2. Resilient Material Isolator Mounts, Non-Seismic:
    - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g. neoprene, rubber) or fiberglass isolator material; fail-safe 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.

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- b. Bottom Load Plate: Non-skid molded elastomeric isolator material or steel with non-skid elastomeric isolator pad with provisions for bolting to supporting structure as required.
  - c. Furnished with integral leveling device for positioning and securing supported equipment.
- 4. Housed Spring Isolators:
  - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
  - b. Furnished with integral elastomeric snubbing elements, non-adjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
  - c. Bottom Load Plate: Steel with non-skid elastomeric isolator pad with provisions for bolting to supporting structure as required.
  - d. Furnished with integral leveling device for positioning and securing supported equipment.
- 5. Restrained Spring Isolators, Non-Seismic:
  - 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 non-skid elastomeric 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.
- 6. Resilient Material Isolator Hangers, Non-Seismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g. neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
- 7. Spring Isolator Hangers, Non-Seismic:
  - 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 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.
- 8. Combination Resilient Material/Spring Isolator Hangers, Non-Seismic:
  - 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) or fiberglass 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.
- D. Vibration Isolators for Seismic Applications:
  - 1. Resilient Material Isolator Mounts, Seismic:
    - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g. neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.
  - 2. Restrained Spring Isolators, Seismic:
    - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g. neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
    - b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.

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- c. Furnished with integral leveling device for positioning and securing supported equipment.
  - d. Provides constant free and operating height.
- 3. Resilient Material Isolator Hangers, Seismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g. neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
- 4. Spring Isolator Hangers, Seismic:
  - 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 element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
  - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.
- 5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
  - 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; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
  - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.

## 2.05 EXTERNAL SEISMIC SNUBBER ASSEMBLIES

- A. Manufacturers:
  - 1. External Seismic Snubber Assemblies:
    - a. Kinetics Noise Control, Inc: [www.kineticsnoise.com/#sle](http://www.kineticsnoise.com/#sle).
    - b. Mason Industries: [www.mason-ind.com/#sle](http://www.mason-ind.com/#sle).
    - c. Vibration Eliminator Company, Inc: [www.veco-nyc.com/#sle](http://www.veco-nyc.com/#sle).
  - 2. Substitutions: See Section 01 6000 - Product Requirements.
  - 3. Source Limitations: Furnish external seismic snubber assemblies and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.
- C. Seismic Snubbing Elements:
  - 1. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
  - 2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

## 2.06 SEISMIC RESTRAINT SYSTEMS

- A. Manufacturers:
  - 1. Seismic Restraint Systems:
    - a. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
    - b. Kinetics Noise Control, Inc: [www.kineticsnoise.com/#sle](http://www.kineticsnoise.com/#sle).
    - c. Mason Industries: [www.mason-ind.com/#sle](http://www.mason-ind.com/#sle).
  - 2. Substitutions: See Section 01 6000 - Product Requirements.
  - 3. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.

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- B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- C. Cable Restraints:
  - 1. Comply with ASCE 19.
  - 2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
  - 3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
  - 4. Use protective thimbles for cable loops where potential for cable damage exists.
- D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

### **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 CODE-REQUIRED SPECIAL INSPECTIONS**

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 01 4533 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
  - 1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
  - 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
- D. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

#### **3.03 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install products in accordance with applicable requirements of 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. Secure fasteners according to manufacturer's recommended torque settings.
- E. Install flexible conduit and cable connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- F. 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.

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- 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. Clean debris from beneath vibration-isolated equipment that could cause short circuiting of isolation.
  5. Use elastomeric grommets for attachments where required to prevent short circuiting of isolation.
  6. Adjust isolators to be free of isolation short circuits during normal operation.
  7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.
- G. Seismic Controls:
  1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris or other obstructions.
  2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
  3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
  4. Equipment with Sheet Metal Housings:
    - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
    - b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
    - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
  5. Concrete Housekeeping Pads:
    - a. Size in accordance with seismic design to meet anchor requirements.
    - b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
  6. Seismic Restraint Systems:
    - a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
    - b. Install restraints within permissible angles in accordance with seismic design.
    - c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
    - d. Install cable restraints for vibration-isolated components slightly slack to prevent short circuiting of isolation.
    - e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

### 3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Provide services of a manufacturer's authorized representative for vibration isolation systems and seismic controls to observe installation and assist in inspection and testing. Include manufacturer's detailed testing and inspection procedures and field reports with submittals.
- D. Vibration Isolation Systems:
  1. Verify isolator static deflections.
  2. Verify required clearance beneath vibration-isolated equipment support bases.

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3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

E. Seismic Controls:

1. Verify snubbing element air gaps.

F. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

### **3.05 ATTACHMENTS**

A. Statement of special inspections.

**END OF SECTION 26 0548**

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## SECTION 26 0553 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 9113 - Exterior Painting.
- B. Section 09 9123 - Interior Painting.
- C. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- D. Section 26 0536 - Cable Trays for Electrical Systems: Additional identification requirements for cable tray systems.
- E. Section 26 0573 - Power System Studies: Arc flash hazard warning labels.
- F. Section 26 2300 - Low-Voltage Switchgear: Factory-installed mimic bus.
- G. Section 26 2726 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.
- H. Section 26 3100 - Photovoltaic Collectors: Additional identification requirements for photovoltaic systems.
- I. Section 27 1000 - Structured Cabling: Identification for communications cabling and devices.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC)
- B. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs.
- C. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace.
- E. UL 969 - Marking and Labeling Systems.

#### 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 3000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

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- C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.
- D. Samples:
  - 1. Identification Nameplates: One of each type and color specified.
  - 2. Warning Signs and Labels: One of each type and legend specified.
- 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. Conform to requirements of CEC.

## 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. Switchgear:
      - 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 and tie devices.
      - 5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
      - 6) See Section 26 2300 for factory-installed mimic bus.
    - b. 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.
    - c. Motor Control Centers:
      - 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.
    - d. 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.

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- 4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
- 5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
- 6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
- e. Transformers:
  - 1) Identify kVA rating.
  - 2) Identify voltage and phase for primary and secondary.
  - 3) Identify power source and circuit number. Include location when not within sight of equipment.
  - 4) Identify load(s) served. Include location when not within sight of equipment.
- f. 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.
- g. 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.
  - 5) Use identification nameplate to identify load(s) served for each plug-in unit. Include location when not within sight of equipment.
- h. Time Switches:
  - 1) Identify load(s) served and associated circuits controlled. Include location.
- i. 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.
- j. 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.
- k. 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.
- l. Electricity Meters:
  - 1) Identify load(s) metered.
2. Service Equipment:
  - a. Use identification nameplate to identify each service disconnecting means.

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- 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 CEC.
    - 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 label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
  - 9. Use identification label or handwritten text using indelible marker 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.
  - 10. Use identification label 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 9123 and 09 9113.
  - 12. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by CEC including but not limited to the following.
    - a. Service equipment.
    - b. Elevator control panels.
    - c. Industrial machinery.
  - 13. Arc Flash Hazard Warning Labels: Comply with Section 26 0573.
  - 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:

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1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
  2. Identification for Communications Conductors and Cables: Comply with Section 27 1000.
  3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
  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.
      - 1) Color Code:
        - (a) Emergency Power System: Red.
      - 2) Field-Painting: Comply with Section 09 9123 and 09 9113.
      - 3) Vinyl Color Coding Electrical Tape: Comply with Section 26 0519.
  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 0536.
- 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 9123 and 09 9113 per the same color code used for raceways.
  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 1000.
  2. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.
  3. Factory Pre-Marked Wallplates: Comply with Section 26 2726.
  4. Use identification label to identify fire alarm system devices.

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- 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 3100

## 2.02 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
  - 1. Manufacturers:
    - a. Brimar Industries, Inc: [www.brimar.com/#sle](http://www.brimar.com/#sle).
    - b. Kolbi Pipe Marker Co{CH#275749}: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
    - c. Seton Identification Products: [www.seton.com/#sle](http://www.seton.com/#sle).
    - d. Substitutions: See Section 01 6000 - 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.
  - 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](http://www.bradyid.com/#sle).
    - b. Brother International Corporation: [www.brother-usa.com/#sle](http://www.brother-usa.com/#sle).
    - c. Panduit Corp: [www.panduit.com/#sle](http://www.panduit.com/#sle).
    - d. Substitutions: See Section 01 6000 - 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.

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- 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.
  - 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.
  - 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:

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1. Brady Corporation: [www.bradyid.com/#sle](http://www.bradyid.com/#sle).
  2. HellermannTyton: [www.hellermannntyton.com/#sle](http://www.hellermannntyton.com/#sle).
  3. Panduit Corp: [www.panduit.com/#sle](http://www.panduit.com/#sle).
  4. Substitutions: See Section 01 6000 - 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.
- F. Minimum Text Height: 1/8 inch.
- G. Color: Black text on white background unless otherwise indicated.

## **2.04 VOLTAGE MARKERS**

- A. Manufacturers:
1. Brady Corporation: [www.bradyid.com/#sle](http://www.bradyid.com/#sle).
  2. Brimar Industries, Inc: [www.brimar.com/#sle](http://www.brimar.com/#sle).
  - 3.
  4. Seton Identification Products: [www.seton.com/#sle](http://www.seton.com/#sle).
- 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".
- F. Color: Black text on orange background unless otherwise indicated.

## **2.05 UNDERGROUND WARNING TAPE**

- A. Manufacturers:
1. Brady Corporation: [www.bradyid.com/#sle](http://www.bradyid.com/#sle).
  2. Brimar Industries, Inc: [www.brimar.com/#sle](http://www.brimar.com/#sle).
  3. Seton Identification Products: [www.seton.com/#sle](http://www.seton.com/#sle).
- 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:

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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](http://www.bradyid.com/#sle).
  2. Brimar Industries, Inc: [www.brimar.com/#sle](http://www.brimar.com/#sle).
  3. Seton Identification Products: [www.seton.com/#sle](http://www.seton.com/#sle).
- 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](http://www.brimar.com/#sle).
  2. Clarion Safety Systems, LLC: [www.clarionsafety.com/#sle](http://www.clarionsafety.com/#sle).
  3. Seton Identification Products: [www.seton.com/#sle](http://www.seton.com/#sle).
  4. Substitutions: See Section 01 6000 - 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.
  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.

## **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.

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- 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.
- 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 4000 - Quality Requirements, for additional requirements.
- B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

**END OF SECTION 26 0553**

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## SECTION 26 0573 POWER SYSTEM STUDIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Short-circuit study.
- B. Protective device coordination study.
- C. Arc flash and shock risk assessment.
  - 1. Includes arc flash hazard warning labels.
- D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

#### 1.02 RELATED REQUIREMENTS

- A. Section 26 0553 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.
- B. Section 26 1116 - Secondary Unit Substations.
- C. Section 26 1300 - Medium-Voltage Switchgear.
- D. Section 26 1321 - Air Interrupter Switches.
- E. Section 26 1839 - Medium-Voltage Motor Controllers.
- F. Section 26 2100 - Low-Voltage Electrical Service Entrance.
  - 1. Includes Utility Company contact information.
- G. Section 26 2300 - Low-Voltage Switchgear.
- H. Section 26 2413 - Switchboards.
- I. Section 26 2416 - Panelboards.
- J. Section 26 2419 - Motor-Control Centers.
- K. Section 26 2513 - Low-Voltage Busways.
- L. Section 26 2813 - Fuses.
- M. Section 26 2816.13 - Enclosed Circuit Breakers.
- N. Section 26 2816.16 - Enclosed Switches.
- O. Section 26 2913 - Enclosed Controllers.
- P. Section 26 3323 - Central Battery Equipment.
- Q. Section 26 3533.16 - Low-Voltage Power Factor Correction Equipment.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.
- C. IEEE 141 - IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants.
- D. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
- E. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis.
- F. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems.
- G. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations.
- H. NEMA MG 1 - Motors and Generators.
- I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

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J. NFPA 70E - Standard for Electrical Safety in the Workplace.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Existing Installations: Coordinate with equipment manufacturer(s) to obtain data necessary for completion of studies.
  - 2. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
  - 3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Pre-Study Meeting: Conduct meeting with Owner to discuss system operating modes and conditions to be considered in studies.
- C. Sequencing:
  - 1. Submit study reports prior to or concurrent with product submittals.
  - 2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.
  - 3. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels (where applicable).
- D. Scheduling:
  - 1. Arrange access to existing facility for data collection with Owner.
  - 2. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Study preparer's qualifications.
- C. Field testing agency's qualifications.
- D. Study reports, stamped or sealed and signed by study preparer.
- E. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
  - 1. Include characteristic time-current trip curves for protective devices.
  - 2. Include impedance data for busway.
  - 3. Include impedance data for engine generators.
  - 4. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
  - 5. Include documentation of listed series ratings upon request.
  - 6. Identify modifications made in accordance with studies that:
    - a. Can be made at no additional cost to Owner.
    - b. As submitted will involve a change to the contract sum.
- F. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.
- G. Site-specific arc flash hazard warning labels.
- H. Field quality control reports.
- I. Certification that field adjustable protective devices have been set in accordance with requirements of studies.
- J. Project Record Documents: Revise studies as required to reflect as-built conditions.
  - 1. Include hard copies with operation and maintenance data submittals.
  - 2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

#### **1.06 POWER SYSTEM STUDIES**

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- A. Scope of Studies:
  1. Perform analysis of new electrical distribution system as indicated on drawings.
  2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
  3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
    - a. Known Operating Modes:
      - 1) Utility as source.
- B. General Study Requirements:
  1. Comply with NFPA 70.
  2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.
- C. Data Collection:
  1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
    - a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
      - 1) Obtain up-to-date information from Utility Company.
      - 2) Utility Company: See Section 26 2100 for Utility Company contact information.
    - b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
    - c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
    - d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
    - e. Protective Devices:
      - 1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
      - 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
    - f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
    - g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.
  2. Existing Installations:
    - a. Provide the services of field testing agency or equipment manufacturer's representative to perform field data collection.
    - b. Collect data on existing electrical distribution system necessary for completion of studies, including field verification of available existing data (e.g. construction documents, previous studies). Include actual settings for field-adjustable devices.
    - c. Available Existing Data:
- D. Short-Circuit Study:
  1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
  2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
    - a. Maximum utility fault currents.
    - b. Maximum motor contribution.

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- c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
  3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.
- E. Protective Device Coordination Study:
  1. Comply with applicable portions of IEEE 242 and IEEE 399.
  2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
  3. Analyze protective devices and associated settings for suitable margins between time-current curves to achieve full selective coordination while providing adequate protection for equipment and conductors.
- F. Arc Flash and Shock Risk Assessment:
  1. Comply with NFPA 70E.
  2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
    - a. To clarify IEEE 1584 statement that "equipment below 240 V need not be considered unless it involves at least one 125 kVA or larger low-impedance transformer in its immediate power supply" for purposes of studies, study preparer to include equipment rated less than 240 V fed by transformers less than 125 kVA in calculations.
    - b. Where reasonable, study preparer may assume a maximum clearing time of two seconds in accordance with IEEE 1584, provided that the conditions are such that a worker's egress from an arc flash event would not be inhibited.
    - c. For single-phase systems, study preparer to perform calculations assuming three-phase system in accordance with IEEE 1584 yielding conservative results.
  3. For equipment with main devices mounted in separate compartmentalized sections, perform calculations on both the line and load side of the main device.
  4. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
    - a. Maximum and minimum utility fault currents.
    - b. Maximum and minimum motor contribution.
    - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
- G. Study Reports:
  1. General Requirements:
    - a. Identify date of study and study preparer.
    - b. Identify study methodology and software product(s) used.
    - c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
    - d. Identify base used for per unit values.
    - e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
    - f. Include conclusions and recommendations.
  2. Short-Circuit Study:
    - a. For each scenario, identify at each bus location:
      - 1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
      - 2) Fault point X/R ratio.
      - 3) Associated equipment short circuit current ratings.
    - b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
  3. Protective Device Coordination Study:

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- a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
  - b. For each graph include (where applicable):
    - 1) Partial single-line diagram identifying the portion of the system illustrated.
    - 2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
    - 3) Conductors: Damage curves.
    - 4) Transformers: Inrush points and damage curves.
    - 5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
    - 6) Motors: Full load current, starting curves, and damage curves.
    - 7) Capacitors: Full load current and damage curves.
  - c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
    - 1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
    - 2) Include ground fault pickup and delay.
    - 3) Include fuse ratings.
    - 4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
  - d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.
4. Arc Flash and Shock Risk Assessment:
- a. For each scenario, identify at each bus location:
    - 1) Calculated incident energy and associated working distance.
    - 2) Calculated arc flash boundary.
    - 3) Bolted fault current.
    - 4) Arcing fault current.
    - 5) Clearing time.
    - 6) Arc gap distance.
  - b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.
  - c. Identify locations where the calculated maximum incident energy exceeds 40 calories per sq cm.

## 1.07 QUALITY ASSURANCE

- A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in the preparation of studies of similar type and complexity using specified computer software.
  1. Study preparer may be employed by the manufacturer of the electrical distribution equipment.
  2. Study preparer may be employed by field testing agency.
  3. Acceptable Study Preparers:
- B. Field Testing Agency Qualifications: Independent testing organization specializing in testing, analysis, and maintenance of electrical systems with minimum five years experience; NETA Accredited Company.
  1. Field Supervisor: Certified electrical testing technician; NETA ETT Level III.
- C. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
  1. Acceptable Software Products:
    - a. EasyPower LLC: [www.easypower.com/#sle](http://www.easypower.com/#sle).
    - b. ETAP/Operation Technology, Inc: [www.etap.com/#sle](http://www.etap.com/#sle).

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- c. Power Analytics Corporation: [www.poweranalytics.com/#sle](http://www.poweranalytics.com/#sle).
- d. SKM Systems Analysis, Inc: [www.skm.com/#sle](http://www.skm.com/#sle).

## **PART 2 PRODUCTS**

### **2.01 ARC FLASH HAZARD WARNING LABELS**

- A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
  - 1. Materials: Comply with Section 26 0553.
  - 2. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
    - a. Include orange header that reads "WARNING" where calculated incident energy is less than 40 calories per square cm.
    - b. Include red header that reads "DANGER" where calculated incident energy is 40 calories per square cm or greater.
    - c. Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" or approved equivalent.
    - d. Include the following information:
      - 1) Arc flash boundary.
      - 2) Available incident energy and corresponding working distance.
      - 3) Site-specific PPE (personnel protective equipment) requirements.
      - 4) Nominal system voltage.
      - 5) Limited approach boundary.
      - 6) Restricted approach boundary.
      - 7) Equipment identification.
      - 8) Date calculations were performed.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install arc flash warning labels in accordance with Section 26 0553.

### **3.02 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Provide the services of field testing agency or equipment manufacturer's representative to perform inspection, testing, and adjusting.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Adjust equipment and protective devices for compliance with studies and recommended settings.
- E. Notify Architect of any conflicts with or deviations from studies. Obtain direction before proceeding.
- F. Submit detailed reports indicating inspection and testing results, and final adjusted settings.

### **3.03 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Training: Include as part of the base bid training for Owner's personnel on electrical safety pertaining to arc flash and shock hazards.
  - 1. Use site-specific arc flash and shock risk assessment report as training reference, supplemented with additional training materials as required.
  - 2. Provide minimum of eight hours of training.
  - 3. Instructor: Representative of entity performing study.
  - 4. Location: At project site.

### **3.04 ATTACHMENTS**

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- A. Previous studies.
- B. Existing drawings.

**END OF SECTION 26 0573**

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## SECTION 26 0583 WIRING CONNECTIONS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Electrical connections to equipment.

#### 1.02 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 0533.13 - Conduit for Electrical Systems.
- C. Section 26 0533.16 - Boxes for Electrical Systems.
- D. Section 26 2726 - Wiring Devices.
- E. Section 26 2816.16 - Enclosed Switches.
- F. Section 26 2913 - Enclosed Controllers.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. NEMA WD 1 - General Color Requirements for Wiring Devices.
- C. NEMA WD 6 - Wiring Devices - Dimensional Specifications.

#### 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 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

#### 1.06 QUALITY ASSURANCE

- A. Conform to requirements of CEC.
- 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: Conform to NEMA WD 1.
  - 2. Cord Construction: CEC, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
  - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches: As specified in Section 26 2816.16 and in individual equipment sections.

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- C. Wiring Devices: As specified in Section 26 2726.
- D. Flexible Conduit: As specified in Section 26 0533.13.
- E. Wire and Cable: As specified in Section 26 0519.
- F. Boxes: As specified in Section 26 0533.16.

## **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.

**END OF SECTION 26 0583**

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## SECTION 26 0923 LIGHTING CONTROL DEVICES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Occupancy sensors.
- B. Outdoor motion sensors.
- C. Time switches.
- D. In-wall time switches.
- E. In-wall interval timers.
- F. Outdoor photo controls.
- G. Daylighting controls.
- H. Lighting contactors.
- I. Control accessories.

#### 1.02 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems
- C. Section 26 0533.16 - Boxes for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 0573 - Power System Studies.
- F. Section 26 0918 - Remote Control Switching Devices: Remotely controlled devices for lighting control, including networked lighting controls, programmable relay panels, and remote control switching relays.
- G. Section 26 2726 - Wiring Devices: Devices for manual control of lighting, including wall switches.
  - 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.
- H. Section 26 2813 - Fuses.
- I. Section 26 2913 - Enclosed Controllers : General purpose contactors.
- J. Section 26 5100 - Interior Lighting.
- K. Section 26 5561 - Theatrical Lighting: Controls for stage lighting units.
- L. Section 26 5600 - Exterior Lighting.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. 47 CFR 15 - Radio Frequency Devices.
- 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.
- D. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- F. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

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- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- H. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices.
- I. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.
- J. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
- K. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
- L. UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting.
- M. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control.
- N. UL 916 - Energy Management Equipment.
- O. UL 917 - Clock-Operated Switches.
- P. UL 1472 - Solid-State Dimming Controls.
- Q. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules.
- R. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters.

#### **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 the 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 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
  - 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Shop Drawings:
  - 1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
  - 2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo 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.

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- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Locking Receptacle-Mounted Outdoor Photo Controls: Five percent of total quantity installed for each type, but not less than two of each type.
  - 3. Indicating Lights: Two of each different type.
- H. Project Record Documents: Record actual installed locations and settings for lighting control devices.

#### **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of CEC.
- 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 7800 - Closeout Submittals, 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.
- C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

#### **2.02 OCCUPANCY SENSORS**

- A. Manufacturers:
  - 1. Hubbell Incorporated: [www.hubbell.com/#sle](http://www.hubbell.com/#sle).
  - 2. Acuity Control: [acuitybrands.com](http://acuitybrands.com)
  - 3. Sensor Switch Inc: [www.sensorswitch.com/#sle](http://www.sensorswitch.com/#sle).
  - 4. WattStopper: [www.wattstopper.com/#sle](http://www.wattstopper.com/#sle).
  - 5. Substitutions: See Section 01 6000 - Product Requirements.
  - 6. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. All Occupancy Sensors:

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1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
2. Sensor Technology:
  - a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
  - b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
  - c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
  - d. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and audible sound sensing 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. Integral Photocell: For field selectable and adjustable inhibition of automatic turn-on of load when ambient lighting is above the selected level.
11. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
12. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
13. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.
14. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
15. Wireless Sensors:
  - a. RF Range: 30 feet through typical construction materials.
  - b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
  - c. Power: Battery-operated with minimum ten-year battery life.
- 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.

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- 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. Provide selectable audible alert to notify occupant of impending load turn-off.
  - g. Finish: Match finishes specified for wiring devices in Section 26 2726, unless otherwise indicated.
  - h. Provide vandal resistant lenses for passive infrared (PIR) and dual technology wall switch occupancy sensors where indicated.
- 2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
  - a. Products:
    - 1) nLight Wall POD; acuitybrands.com
- 3. Ultrasonic Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 400 square feet.
  - a. Products:
    - 1) nLight Wall POD; acuitybrands.com
- D. Wall Dimmer Occupancy Sensors:
  - 1. General Requirements:
    - 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 2726, unless otherwise indicated.
  - 2. Passive Infrared (PIR) Wall Dimmer Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
    - a. Products:
      - 1) nLight Wallpods ; acuitybrands.com
      - 2) nLight Wallpods Maestro Occupancy Sensor Dimmer Series; acuitybrands.com
      - 3) nLight Wallpods ; www.lutron.com/#sle.
      - 4) Nlight nPOD Key Switches; acuitybrands.com
- 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.

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- e. Finish: White unless otherwise indicated.
2. Passive Infrared (PIR) 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.
    - 1) Products:
      - (a) nLight nCM series; acuitybrands.com
      - (b) [\_\_\_\_\_].
      - (c) Substitutions: See Section 01 6000 - Product Requirements.
  - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
    - 1) Products:
      - (a) nLight nCM series; acuitybrands.com
      - (b) [\_\_\_\_\_].
      - (c) Substitutions: See Section 01 6000 - Product Requirements.
3. Ultrasonic Ceiling Mounted Occupancy Sensors:
  - a. Standard Range Sensors: Capable of detecting motion within an area of 500 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
    - 1) Products:
      - (a) nLight nCM series; acuitybrands.com
  - b. Medium Range Sensors: Capable of detecting motion within an area of 1,000 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
    - 1) Products:
      - (a) nLight nCM series; acuitybrands.com
4. 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.
    - 1) Products:
      - (a) nLight nCM series; acuitybrands.com
  - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
    - 1) Products:
      - (a) nLight nCM series; acuitybrands.com
5. Passive Infrared/Acoustic 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.
- 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 (PIR) Directional Occupancy Sensors:
    - a. Standard Range Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.
      - 1) Products:
        - (a) nLight nWV series; acuitybrands.com
- G. Luminaire Mounted Occupancy Sensors: Designed for direct luminaire installation and control, suitable for use with specified luminaires.
- H. 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.

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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.
- I. Power Packs for Wireless Occupancy Sensors:
  1. Description: Plenum rated, self-contained relay compatible with specified wireless occupancy sensors for switching of line voltage loads.
  2. Input Supply Voltage: Dual rated for 120/277 V ac.
  3. Load Rating: As required to control the load indicated on drawings.

## 2.03 OUTDOOR MOTION SENSORS

- A. Manufacturers:
  1. Hubbell Lighting, Inc: [www.hubbellighting.com/#sle](http://www.hubbellighting.com/#sle).
  2. Acuity Brands: [acuitybrands.com](http://acuitybrands.com)
- B. Description: Factory-assembled wet location listed device suitable for wall or ceiling/eave mounting, with integral swivel for field adjustment of coverage, capable of detecting motion for automatic control of load indicated.
- C. Sensor Technology: Passive Infrared (PIR) designed to detect occupancy by sensing movement of thermal energy between zones.
- D. Operation: Unless otherwise indicated, motion sensor to turn load on when motion is detected and to turn load off when no motion is detected during an adjustable turn-off delay time interval.
- E. Turn-Off Delay: Field adjustable, with time delay settings available up to 15 minutes.
- F. Integral Photocell: For dusk to dawn operation.
- G. Manual Override: Activated by switching power off to unit and then back on.
- H. Load Rating: 1,000 W incandescent and fluorescent load at 120 V ac.
- I. Coverage: Capable of detecting motion within a distance of 50 feet at a mounting height of 8 feet, with a field of view of 270 degrees.

## 2.04 TIME SWITCHES

- A. Manufacturers:
  1. Intermatic, Inc: [www.intermatic.com/#sle](http://www.intermatic.com/#sle).
  2. Tork, a division of NSI Industries LLC: [www.tork.com/#sle](http://www.tork.com/#sle).
  3. Substitutions: See Section 01 6000 - Product Requirements.
  4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. Digital Electronic Time Switches:
  1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
  2. Program Capability:
    - a. 24-Hour Time Switches: Single channel, with same schedule for each day of the week and skip-a-day feature to omit selected days.
    - b. 7-Day Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days.
    - c. Astronomic Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
  3. Schedule Capacity: Not less than 16 programmable on/off operations.
  4. Provide automatic daylight savings time and leap year compensation.
  5. Provide power outage backup to retain programming and maintain clock.

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6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
7. Input Supply Voltage: As indicated on the drawings.
8. Output Switch Configuration: As required to control the load indicated on drawings.
9. Output Switch Contact Ratings: As required to control the load indicated on drawings.
10. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:

## **2.05 IN-WALL TIME SWITCHES**

## **2.06 IN-WALL INTERVAL TIMERS**

## **2.07 OUTDOOR PHOTO CONTROLS**

- A. Manufacturers:
  1. Acuity Brands: [acuitybrands.com](http://acuitybrands.com)
  2. Tork, a division of NSI Industries LLC: [www.tork.com/#sle](http://www.tork.com/#sle).
- B. Stem-Mounted Outdoor Photo Controls:
  1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
  2. Housing: Weatherproof, impact resistant polycarbonate.
  3. Photo Sensor: Cadmium sulfide.
  4. Provide external sliding shield for field adjustment of light level activation.
  5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
  6. Voltage: As required to control the load indicated on the drawings.
  7. Failure Mode: Fails to the on position.
  8. Load Rating: As required to control the load indicated on the drawings.
  9. Provide accessory wall-mounting bracket where indicated or as required to complete installation.
- C. Locking Receptacle-Mounted Outdoor Photo Controls
  1. Description: Plug-in locking type photo control unit complying with ANSI C136.10 for mounting on a compatible receptacle, listed and labeled as complying with UL 773.
  2. Housing: Weatherproof, impact resistant UV stabilized polypropylene, color to be selected.
  3. Photo Sensor: Cadmium sulfide.
  4. Light Level Activation: 1 to 3 footcandles turn-on and 1.5 to 1 turn-off to turn-on ratio with instant turn-on and delayed turn-off.
  5. Voltage: As required to control the load indicated on the drawings.
  6. Failure Mode: Fails to the on position.
  7. Load Rating: As required to control the load indicated on the drawings.
  8. Surge Protection: 160 joule metal oxide varistor.
  9. Provide the following accessories where indicated or as required to complete installation:
    - a. Receptacle: Complying with ANSI C136.10.
    - b. Mounting Bracket.
    - c. Shorting Cap: Suitable for replacing locking photo control to complete circuit.
- D. Manufacturers:
  1. Hubbell Control Solutions: [www.hubbell.com/hubbellcontrolsolutions/en/#sle](http://www.hubbell.com/hubbellcontrolsolutions/en/#sle).
  2. Acuity brands; [acuitybrands.com](http://acuitybrands.com)
  3. Sensor Switch Inc: [www.sensorswitch.com/#sle](http://www.sensorswitch.com/#sle).
  4. WattStopper: [www.wattstopper.com/#sle](http://www.wattstopper.com/#sle).
- E. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.

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- F. Daylighting Control Photo Sensors: Low voltage class 2 photo sensor units with output signal proportional to the measured light level and provision for zero or offset based signal.
  1. Sensor Type: Filtered silicon photo diode.
  2. Sensor Range:
    - a. Indoor Photo Sensors: 5 to 100 footcandles.
    - b. Outdoor Photo Sensors: 5 to 250 footcandles.
    - c. Atrium Photo Sensors: 200 to 2,500 footcandles.
    - d. Skylight Photo Sensors: 1,000 to 6,000 footcandles.
    - e. Open Loop Photo Sensors: 3 to 6,000 footcandles.
  3. Finish: White unless otherwise indicated.
  4. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
  5. Wireless Daylighting Control Photo Sensors:
    - a. RF Range: 30 feet through typical construction materials.
    - b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
    - c. Power: Battery-operated with minimum ten-year battery life.
    - d. Products:
      - 1) Lutron Radio Powr Savr Wireless Sensors; [www.lutron.com/#sle](http://www.lutron.com/#sle).
- G. Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming ballasts, for direct continuous dimming of up to 50 ballasts.
- H. Daylighting Control Switching Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors, for switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
  1. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
  2. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
  3. Control Capability:
    - a. Single Zone Switching Modules: Capable of controlling one programmable channel.
    - b. Multi-Zone Switching Modules: Capable of controlling up to three separately programmable channels.
- I. Daylighting Control Switching Modules for Wireless Sensors:
  1. Description: Plenum rated, self-contained relay compatible with specified wireless photo sensors for switching of line voltage loads in response to changes in measured light levels according to selected settings.
  2. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
  3. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
  4. Control Capability: Capable of controlling one programmable channel.
  5. Input Supply Voltage: Dual rated for 120/277 V ac.
- J. Daylighting Control Dimming Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors and with specified dimming ballasts, for both continuous dimming of compatible dimming ballasts and switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
  1. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
  2. Control Capability: Capable of controlling up to three separately programmable channels, with up to 50 ballasts per channel.

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3. Dimming and Fade Rates: Adjustable from 5 to 60 seconds.
4. Cut-Off Delay: Selectable and adjustable from 0 to 20 minutes.
- K. Daylighting Control Dimming Modules for Wireless Sensors:
  1. Description: Plenum rated control unit compatible with specified wireless photo sensors and with specified dimming ballasts, for continuous dimming of compatible dimming ballasts in response to changes in measured light levels according to selected settings.
  2. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
  3. Load to be turned off when available daylight is sufficient to fully dim the load, after the selected time delay.
  4. Control Capability: Capable of controlling up to 32 ballasts with up to two separately programmable daylighting zones.
- L. Power Packs for Low Voltage Daylighting Control Modules:
  1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage daylighting control modules for switching of line voltage loads. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
  2. Input Supply Voltage: Dual rated for 120/277 V ac.
  3. Load Ratings: As required to control the load indicated on drawings.
- M. Accessories:
  1. Where indicated, provide compatible accessory wall switches for manual override control.
  2. Where indicated, provide compatible accessory wireless controls for manual override control.
    - a. Products:
      - 1) Lutron Pico Wireless Controls; [www.lutron.com/#sle](http://www.lutron.com/#sle).

## 2.08 LIGHTING CONTACTORS

- A. Manufacturers:
  1. nLight ARP; [acuitybrands.com](http://acuitybrands.com)
- B. Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; noncombination type unless otherwise indicated; ratings, configurations and features as indicated on the drawings.
- C. Short Circuit Current Rating:
- D. Enclosures:
  1. Comply with NEMA ICS 6.
  2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
  3. Finish: Manufacturer's standard unless otherwise indicated.

## 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 CEC.
- 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.

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- 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. Coordinate locations of outlet boxes provided under Section 26 0533.16 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.
    - b. In-Wall Time Switches: 48 inches above finished floor.
    - c. In-Wall Interval Timers: 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.
- C. Install lighting control devices in accordance with manufacturer's instructions.
- D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- E. Install lighting control devices plumb and level, and held securely in place.
- F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 2726.
- G. Provide required supports in accordance with Section 26 0529.
- H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- I. Identify lighting control devices in accordance with Section 26 0553.
- J. Occupancy Sensor Locations:
  - 1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Architect.
  - 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.
- K. Outdoor Photo Control Locations:
  - 1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
  - 2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.
- L. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.
- M. Daylighting Control Photo Sensor Locations:

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1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Architect.
  2. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure the light level controlled at the designated task location, while minimizing the measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
  3. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into the space, while minimizing the measured amount of lighting from artificial sources.
- N. Combination Enclosed Lighting Contactors:
1. Except where indicated to be mounted adjacent to the equipment they supply, mount lighting contactors such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- O. 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.
- P. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.
- Q. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- D. Test time switches to verify proper operation.
- E. Test outdoor photo controls to verify proper operation, including time delays where applicable.
- F. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.
- G. 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.
- E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.
- F. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect.

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- G. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

### **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 9113 - General Commissioning Requirements for commissioning requirements.

### **3.08 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, 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 26 0923**

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## SECTION 26 2100 LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Electrical service requirements.

#### 1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Materials and installation requirements for cast-in-place concrete equipment pads.
- B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- D. Section 26 0529 - Hangers and Supports for Electrical Systems.
- E. Section 26 0533.13 - Conduit for Electrical Systems.
- F. Section 26 0533.23 - Surface Raceways for Electrical Systems: Wireways.
- G. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 26 2300 - Low-Voltage Switchgear: Service entrance equipment.
- I. Section 26 2413 - Switchboards: Service entrance equipment.
- J. Section 26 2416 - Panelboards: Service entrance equipment.
- K. Section 26 2713 - Electricity Metering: Non-utility electrical metering.

#### 1.03 PRICE AND PAYMENT PROCEDURES

- A. Allowances:
  - 1. See Section 01 2100 - Allowances, for allowances affecting this section.
  - 2. Include cash allowance for Utility Company charges associated with providing service.
- B. Unit Prices:
  - 1. See Section 01 2200 - Unit Prices, 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 CEC, and as designated by the Utility Company.

#### 1.05 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. IEEE C2 - National Electrical Safety Code.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction.

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## 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. 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. Arrange for inspections necessary to obtain Utility Company approval of installation.

## 1.07 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

## 1.08 QUALITY ASSURANCE

- A. Comply with the following:
  - 1. IEEE C2 (National Electrical Safety Code).
  - 2. CEC (California Electrical Code).
  - 3. The requirements of the Utility Company.
- 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.

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- B. Electrical Service Characteristics: As indicated on drawings.
- C. Utility Company: As indicated on drawings.
- D. Division of Responsibility: As indicated on drawings.
- 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 support and attachment components in accordance with Section 26 0529.
- E. Provide grounding and bonding for service entrance equipment in accordance with Section 26 0526.
- F. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 0553.

#### **3.04 PROTECTION**

- A. Protect installed equipment from subsequent construction operations.

**END OF SECTION 26 2100**

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## SECTION 26 2200 LOW-VOLTAGE TRANSFORMERS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. General purpose transformers.

#### 1.02 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0533.13 - Conduit for Electrical Systems: Flexible conduit connections.
- D. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
  - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 2416 - Panelboards.
- G. Section 26 2713 - Electricity Metering: Instrument transformers for electrical metering.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. 10 CFR 431, Subpart K - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers.
- C. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers.
- D. IEEE C57.96 - IEEE Standard Guide for Loading Dry-Type Distribution and Power Transformers.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- F. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers.
- G. NEMA ST 20 - Dry-Type Transformers for General Applications.
- H. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- J. UL 506 - Standard for Specialty Transformers.
- K. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers.

#### 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 required by CEC.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
  - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

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- B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.
  - 1. Vibration Isolators: Include attachment method and rated load and deflection.
- C. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.
- D. Manufacturer's equipment seismic qualification certification.
- E. Source Quality Control Test Reports: Include reports for tests designated in NEMA ST 20 as design and routine tests.
- 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. Maintenance Data: Include recommended maintenance procedures and intervals.
- I. Project Record Documents: Record actual locations of transformers.

#### **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of CEC.
- 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. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

#### **1.08 FIELD CONDITIONS**

- A. Ambient Temperature: Do not exceed the following maximum temperatures during and after installation of transformers.
  - 1. Greater than 10 kVA: 104 degrees F maximum.
  - 2. Less than 10 kVA: 77 degrees F maximum.
- B. Ambient Temperature: Do not exceed 86 degrees F average or 104 degrees F maximum measured during any 24 hour period during and after installation of transformers.

#### **1.09 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. ABB/GE: [www.geindustrial.com/#sle](http://www.geindustrial.com/#sle).
- B. Eaton Corporation [www.eaton.com/#sle](http://www.eaton.com/#sle).
- C. Schneider Electric; Square D Products: [www.schneider-electric.us/#sle](http://www.schneider-electric.us/#sle).
- D. Siemens Industry, Inc: [www.usa.siemens.com/#sle](http://www.usa.siemens.com/#sle).

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E. Substitutions: See Section 01 6000 - Product Requirements.

## 2.02 TRANSFORMERS - GENERAL REQUIREMENTS

- A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.
- B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
  - 1. Altitude: Less than 3,300 feet.
  - 2. Ambient Temperature:
    - a. Greater than 10 kVA: Not exceeding 104 degrees F.
    - b. Less than 10 kVA: Not exceeding 77 degrees F.
  - 3. Ambient Temperature: Not exceeding 86 degrees F average or 104 degrees F maximum measured during any 24 hour period.
- C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.
- D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.
- E. Basic Impulse Level: 10 kV.
- F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- G. Isolate core and coil from enclosure using vibration-absorbing mounts.
- H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

## 2.03 GENERAL PURPOSE TRANSFORMERS

- A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.
- B. Primary Voltage: 480 volts delta, 3 phase.
- C. Secondary Voltage: 208Y/120 volts, 3 phase.
- D. Insulation System and Allowable Average Winding Temperature Rise:
  - 1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
  - 2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.
- E. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.
- F. Winding Taps:
  - 1. Less than 3 kVA: None.
  - 2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
  - 3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
  - 4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.
- G. Energy Efficiency: Comply with 10 CFR 431, Subpart K.
- H. Sound Levels: Standard sound levels complying with NEMA ST 20
- I. Mounting Provisions:
  - 1. Less than 15 kVA: Suitable for wall mounting.
  - 2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.

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3. Larger than 75 kVA: Suitable for floor mounting.
- J. Transformer Enclosure: Comply with NEMA ST 20.
  1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
  2. Construction: Steel.
    - a. Less than 15 kVA: Totally enclosed, non-ventilated.
    - b. 15 kVA and Larger: Ventilated.
  3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
  4. Provide lifting eyes or brackets.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.
- C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.
- D. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 INSTALLATION**

- A. Provide seismic restraints.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install transformers in accordance with NECA 409 and IEEE C57.94.
- E. Use flexible conduit, under the provisions of Section 26 0533.13, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- F. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and CEC.
- G. Install transformers plumb and level.
- H. Transformer Support:
  1. Provide required support and attachment in accordance with Section 26 0529, where not furnished by transformer manufacturer.
  2. Use integral transformer flanges to support wall-mounted transformers.
  3. Unless otherwise indicated, mount floor-mounted transformers on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
  4. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- I. Provide grounding and bonding in accordance with Section 26 0526.
- J. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.
- K. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS Sections 7.2.1.1 and 7.2.1.2. Tests and inspections listed as optional are not required.

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1. 167 kVA single phase, 500 kVA three phase and smaller:
  - a. Perform turns ratio tests at all tap positions.
2. Larger than 167 kVA single phase and 500 kVA three phase:
  - a. Verify that control and alarm settings on temperature indicators are as specified.
  - b. Perform excitation-current tests on each phase.
  - c. Measure the resistance of each winding at each tap connection.
  - d. Perform an applied voltage test on all high- and low-voltage windings-to-ground.

#### **3.04 ADJUSTING**

- A. Measure primary and secondary voltages and make appropriate tap adjustments.
- B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

#### **3.05 CLEANING**

- A. Clean dirt and debris from transformer components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

**END OF SECTION 26 2200**

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## SECTION 26 2300 LOW-VOLTAGE SWITCHGEAR

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Low-voltage (600 V and less) arc-resistant metal-enclosed drawout switchgear and accessories for service and distribution applications.
- B. Low-voltage power circuit breakers for switchgear.

#### 1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
  - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- G. Section 26 2100 - Low-Voltage Electrical Service Entrance.
  - 1. Includes Utility Company contact information.
- H. Section 26 2413 - Switchboards.
- I. Section 26 2419 - Motor-Control Centers.
- J. Section 26 2513 - Low-Voltage Busways.
- K. Section 26 2713 - Electricity Metering: For interface with equipment specified in this section.
- L. Section 26 2813 - Fuses: Fuses for fusible switches.
  - 1. Includes requirements for spare fuses and spare fuse cabinets.
- M. Section 26 4300 - Surge Protective Devices.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. ANSI C37.50 - American National Standard for Switchgear - Low Voltage AC Power Circuit Breakers Used In Enclosures - Test Procedures.
- C. ANSI C37.51 - American National Standard for Switchgear - Metal-Enclosed Low Voltage AC Power Circuit Breaker Switchgear Assemblies - Conformance Test Procedures.
- D. IEEE C37.13 - IEEE Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures.
- E. IEEE C37.16 - IEEE Standard for Preferred Ratings, Related Requirements, and Application Recommendations for Low-Voltage AC (635 V and below) and DC (3200 V and below) Power Circuit Breakers.
- F. IEEE C37.17 - IEEE Standard for Trip Systems for Low-Voltage (1000 V and below) AC and General Purpose (1500 V and below) DC Power Circuit Breakers.
- G. IEEE C37.20.1 - IEEE Standard for Metal-Enclosed Low-Voltage (1000 Vac and below, 3200 Vdc and below) Power Circuit Breaker Switchgear.
- H. IEEE C37.20.7 - IEEE Guide for Testing Switchgear Rated up to 52 kV for Internal Arcing Faults.
- I. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers.
- J. NECA 1 - Standard for Good Workmanship in Electrical Construction.

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- K. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- L. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- M. UL 869A - Reference Standard for Service Equipment.
- N. UL 1053 - Ground-Fault Sensing and Relaying Equipment.
- O. UL 1066 - Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures.
- P. UL 1558 - Switchgear.

#### **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 required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
  - 5. Notify Architect of any conflicts with or deviations Contract Documents. Obtain direction before proceeding with work.
- B. Service Entrance Switchgear:
  - 1. Coordinate with Utility Company to provide switchgear with suitable provisions for electrical service and utility metering, where applicable.
  - 2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
  - 3. See Section 26 2100 for Utility Company contact information and additional requirements.
  - 4. Obtain Utility Company approval of switchgear prior to fabrication.
  - 5. Preinstallation Meeting: Convene one week prior to commencing work of this section to review requirements with Utility Company representative.
  - 6. Arrange for inspections necessary to obtain Utility Company approval of installation.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchgear, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, short-time current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  - 1. Include dimensioned plan and elevation views of switchgear and adjacent equipment with all required clearances indicated.
  - 2. Include wiring diagrams showing all factory and field connections.
  - 3. Include documentation demonstrating selective coordination upon request.
  - 4. Include key-type mechanical interlock scheme with sequence of operations, as applicable.
  - 5. Include proposed mimic bus single-line diagram arrangement.
  - 6. Arc-Resistant Switchgear: Include proposed plenum arrangement, where applicable.
  - 7. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Service Entrance Switchgear: Include documentation of Utility Company approval of switchgear.
- F. Source Quality Control Test Reports: Include reports for tests designated in IEEE C37.20.1 as production tests.

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- 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. Field Quality Control Test Reports.
- I. Project Record Documents: Record actual installed locations of switchgear and final equipment settings.
- J. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Enclosure Keys: Two of each different key.
  - 3. Circuit Breakers:
    - a. Handles Necessary for Racking of Devices: One for each electrical room containing drawout switchgear.
    - b. Lifting Yokes: One of each different yoke required, for each electrical room containing drawout switchgear.
    - c. Removable Covers: One for blocking each different opening size when circuit breaker is temporarily removed from its compartment.
  - 4. See Section 26 2813 for requirements for spare fuses and spare fuse cabinets.

#### **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of CEC.
- 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 switchgear in accordance with manufacturer's instructions and IEEE C37.20.1.
- B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchgear, which is not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.
- C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle carefully to avoid damage to switchgear internal components, enclosure, and finish.

#### **1.08 FIELD CONDITIONS**

- A. Maintain field conditions within required service conditions during and after installation.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Low-Voltage Switchgear - Basis of Design.
- B. Low-Voltage Switchgear - Other Acceptable Manufacturers:
  - 1. ABB/GE: [www.geindustrial.com/#sle](http://www.geindustrial.com/#sle).
  - 2. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
  - 3. Schneider Electric; Square D Products: [www.schneider-electric.us/#sle](http://www.schneider-electric.us/#sle).

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4. Siemens Industry, Inc: [www.usa.siemens.com/#sle](http://www.usa.siemens.com/#sle).

C. Substitutions: See Section 01 6000 - Product Requirements.

## 2.02 LOW-VOLTAGE SWITCHGEAR

- A. Provide switchgear assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Dead-front standard (non-arc-resistant) type metal-enclosed drawout switchgear complying with IEEE C37.20.1 and ANSI C37.51; listed and labeled as complying with UL 1558; ratings, configurations and features as indicated on the drawings.
- D. Configuration:
  - 1. Compartmentalization: Provide barriered compartments for each overcurrent protective device, distribution bus, and rear cable connection area.
  - 2. Arrangement: Rear accessible, front and rear aligned.
  - 3. Rear Access: Bolted covers.
- E. Arc-Resistance Rating:
  - 1. Passes criteria for arc-resistant functionality when tested in accordance with applicable requirements of IEEE C37.20.7 for Type 2 accessibility.
  - 2. Arc exhaust gases must be discharged through a plenum into designated area approved by Architect.
  - 3. Arc resistant rating valid through maximum current of not less than the available fault current at the installed location.
- F. Service Entrance Switchgear:
  - 1. Listed and labeled as suitable for use as service equipment according to UL 869A.
  - 2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
  - 3. Comply with Utility Company requirements for electrical service.
  - 4. Utility Metering Provisions: Provide separate barriered compartment complying with Utility Company requirements where indicated or where required by Utility Company. Include hinged sealable door and provisions for Utility Company current transformers (CTs), potential transformers (PTs), or potential taps as required.
  - 5. See Section 26 2100 for additional requirements.
- G. Switchgear With Busway Transitions: Configured for bussed connection to busway provided in accordance with Section 26 2513.
- H. Switchgear With Fire Pump Taps: Provide separate bussed vertical section with suitable lugs for fire pump connection to line side of main service disconnect device(s).
- I. Provide integral top rail-mounted lifting device where indicated.
- J. Seismic Qualification: Provide switchgear and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.
- K. Service Conditions:
  - 1. Provide switchgear and associated components suitable for operation under the following service conditions without derating:
    - a. Altitude: Less than 6,600 feet.
    - b. Ambient Temperature: Between -22 degrees F and 104 degrees F.
  - 2. Provide switchgear and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- L. Short Circuit Current Rating:
  - 1. Provide switchgear with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

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- M. Short-Time Current (30-Cycle Withstand) Rating: Equivalent to specified short circuit current rating.
- N. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.
- O. Bussing: Sized in accordance with UL 1558 temperature rise requirements.
  - 1. Main bus (horizontal cross bus) to be fully rated through full length of switchgear.
  - 2. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
  - 3. Provide solidly bonded equipment ground bus through full length of switchgear, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
  - 4. Phase and Neutral Bus Material: Copper.
  - 5. Ground Bus Material: Copper.
- P. Conductor Terminations: Suitable for use with the conductors to be installed.
  - 1. Line Conductor Terminations:
    - a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
    - b. Main and Neutral Lug Type: Mechanical.
  - 2. Load Conductor Terminations:
    - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
    - b. Lug Type:
- Q. Enclosures:
  - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1.
    - b. Outdoor Locations: Type 3R.
  - 2. Finish: Manufacturer's standard unless otherwise indicated.
  - 3. Enclosure Space Heaters:
    - a. Provide in each switchgear section installed outdoors and in unconditioned indoor spaces.
    - b. Size according to manufacturer's recommendations for worst case ambient temperature to prevent condensation.
    - c. Heater Control: Thermostat.
    - d. Heater Power Source: Provide connection to transformer factory-installed in switchgear or suitable external branch circuit as indicated or as required.
  - 4. Outdoor Enclosures:
    - a. Enclosure Type: Non-walk-in type unless otherwise indicated.
    - b. Color: Manufacturer's standard.
    - c. Access Doors: Lockable, with all locks keyed alike.
    - d. Walk-in Enclosure Features:
      - 1) Personnel Doors: Open to exterior; equipped with panic hardware.
      - 2) Aisle lighting, with switch at each access door.
      - 3) GFCI duplex convenience receptacle.
- R. Future Provisions:
  - 1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
  - 2. Arrange and equip through bus and ground bus to accommodate future installation of additional switchgear sections.
- S. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list switchgear as a complete assembly including surge protective device.

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- T. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
  - 1. Provide separate neutral current sensor where applicable.
- U. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.
- V. Owner Metering: Comply with Section 26 2713.
- W. Owner Metering:
  - 1. Provide microprocessor-based digital electrical metering system including all instrument transformers, wiring, and connections necessary for measurements specified.
  - 2. Measured Parameters:
    - a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
    - b. Current (Amps): For each phase and neutral.
    - c. Frequency (Hz).
    - d. Real power (kW): For each phase, 3-phase total.
    - e. Reactive power (kVAR): For each phase, 3-phase total.
    - f. Apparent power (kVA): For each phase, 3-phase total.
    - g. Power factor.
    - h. Real energy (kWh).
    - i. Reactive energy (kVARh).
    - j. Apparent energy (kVAh).
    - k. Current demand.
    - l. Power demand: Real, reactive, and apparent.
  - 3. Meter Accuracy: Plus/minus 1.0 percent.
  - 4. Features:
    - a. Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.
    - b. KYZ pulse output.
    - c. Adjustable demand interval.
    - d. Remote monitoring capability via PC.
- X. 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.

### 2.03 LOW-VOLTAGE POWER CIRCUIT BREAKERS

- A. Description: Quick-make, quick-break, trip-free low-voltage power circuit breakers with two-step stored energy closing mechanism; 100 percent rated; complying with IEEE C37.13, IEEE C37.16, IEEE C37.17, and ANSI C37.50; listed and labeled as complying with UL 1066; ratings, configurations, and features as indicated on the drawings.
- B. Interrupting Capacity: Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.
- C. Operation:
  - 1. Provide manually operated circuit breakers unless otherwise indicated.
  - 2. Provide electrically operated circuit breakers where indicated.
  - 3. Pad-Lock Provision: For preventing circuit breaker closing operation.
- D. Construction: Drawout.
  - 1. Allows withdrawal of circuit breaker into test and disconnected positions, with racking position indication (connected, test, disconnected, withdrawn).
  - 2. Provide safety interlock to prevent racking of circuit breaker while in the ON position.

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3. Pad-Lock Provision: For preventing circuit breaker drawout operation.
- E. Fused Circuit Breakers:
  1. Fuses: Class L, selected for coordination with circuit breaker trip units.
  2. Blown Fuse Protection: Provide blown fuse protection to trip circuit breaker in the event of the opening, or absence, of a fuse and to prevent closing of circuit breaker until reset operation is performed; provide blown fuse status indication.
  3. Where fuse is not integral with circuit breaker and mounted in a separate compartment, provide interlock to prevent fuse access with the circuit breaker in the ON position.
- F. Trip Units: Solid state, microprocessor-based, true rms sensing.
  1. Provide the following field-adjustable trip response settings:
    - a. Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
    - b. Long time delay.
    - c. Short time pickup and delay.
    - d. Instantaneous pickup.
      - 1) Include instantaneous function for feeder circuit breakers.
      - 2) Omit instantaneous function or provide ability to turn instantaneous function off for main and tie circuit breakers.
    - e. Ground fault pickup and delay where ground fault protection is indicated.
  2. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
  3. Provide communication capability where indicated: Compatible with system indicated.
- G. Provide the following features and accessories where indicated or where required to complete installation:
  1. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
  2. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
  3. Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
  4. Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.
  5. Truck-Operated Cell Switch: For indicating circuit breaker racking position.

## 2.04 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Factory test switchgear according to IEEE C37.20.1, including the following production tests on each switchgear assembly or component:
  1. Dielectric tests.
  2. Mechanical operation tests.
  3. Grounding of instrument transformer cases test.
  4. Electrical operation and control wiring tests, including polarity and sequence tests.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the switchgear and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive switchgear.
- D. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

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- A. Install products in accordance with manufacturer's instructions.
- B. Install switchgear in accordance with NECA 1 (general workmanship) and IEEE C37.20.1.
- C. Arrange equipment to provide required clearances and maintenance access, including accommodations for drawout circuit breakers.
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Install switchgear plumb and level.
- F. Unless otherwise indicated, mount switchgear on properly sized 4 inch high concrete pad constructed in accordance with Section 03 3000.
- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Install all 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 circuit breaker tripping function settings as indicated.
- K. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- L. Identify switchgear in accordance with Section 26 0553.

### 3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - 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 reports with submittals.
- C. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- D. Before energizing switchgear, perform preoperation checks in accordance with IEEE C37.20.1.
- E. Inspect and test in accordance with NETA ATS, except Section 4.
- F. Perform inspections and tests listed in NETA ATS, Section 7.1.
- G. Low-Voltage Power Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.2 for all main circuit breakers and circuit breakers larger than [ ] amperes. Tests listed as optional are not required.
  - 1. Perform insulation-resistance tests on all control wiring with respect to ground.
  - 2. Test functions of the trip unit by means of secondary injection.
- H. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
  - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
- I. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.
- J. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.
- K. Test shunt trips to verify proper operation.
- L. Correct deficiencies and replace damaged or defective switchgear assemblies or associated components.
- M. Submit detailed reports indicating inspection and testing results and corrective actions taken.

### 3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of switchgear covers and doors.

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### **3.05 CLEANING**

- A. Clean dirt and debris from switchgear enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred surfaces to match original factory finish.

### **3.06 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Training: Train Owner's personnel on operation, adjustment, and maintenance of switchgear 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 switchgear assemblies from subsequent construction operations.

**END OF SECTION 26 2300**

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## SECTION 26 2413 SWITCHBOARDS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.
- B. Overcurrent protective devices for switchboards.

#### 1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
  - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- G. Section 26 2100 - Low-Voltage Electrical Service Entrance.
  - 1. Includes Utility Company contact information.
- H. Section 26 2300 - Low-Voltage Switchgear.
- I. Section 26 2513 - Low-Voltage Busways.
- J. Section 26 2813 - Fuses: Fuses for fusible switches.
  - 1. Includes requirements for spare fuses and spare fuse cabinets.
- K. Section 26 4300 - Surge Protective Devices.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
- C. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- E. NECA 400 - Standard for Installing and Maintaining Switchboards.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- G. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).
- H. NEMA PB 2 - Deadfront Distribution Switchboards.
- I. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.
- J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- K. UL 98 - Enclosed and Dead-Front Switches.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
- M. UL 869A - Reference Standard for Service Equipment.
- N. UL 891 - Switchboards.
- O. UL 977 - Fused Power-Circuit Devices.
- P. UL 1053 - Ground-Fault Sensing and Relaying Equipment.

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#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the electrical outage time with the school district for crossover of power when the new switchboard is installed. Do not disconnect power from the school without written authorization. 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 required by NFPA 70.
  - 2. 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 required by NFPA 70.
  - 3. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 5. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
  - 6. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Service Entrance Switchboards:
  - 1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.
  - 2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
  - 3. Obtain Utility Company approval of switchboard prior to fabrication.
  - 4. Arrange for inspections necessary to obtain Utility Company approval of installation.

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.
  - 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  - 1. Include dimensioned plan and elevation views of switchboards and adjacent equipment with all required clearances indicated.
  - 2. Include wiring diagrams showing all factory and field connections.
  - 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
  - 4. Include documentation of listed series ratings upon request.
  - 5. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Service Entrance Switchboards: Include documentation of Utility Company approval of switchboard.
- F. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 2 as production (routine) tests.
- 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. Field Quality Control Test Reports.

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- I. Project Record Documents: Record actual installed locations of switchboards and final equipment settings.
- J. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Enclosure Keys: Two of each different key.
  - 3. Electronic Trip Circuit Breakers: Provide one portable test set.
  - 4. Drawout Devices:
    - a. Handles Necessary for Racking of Devices: One for each electrical room containing switchgear with drawout devices.
    - b. Lifting Yokes: One of each different yoke required, for each electrical room containing drawout devices.
    - c. Portable Lifting Devices: One for each electrical room containing switchboards with drawout devices and no integral top rail-mounted lifting device.
    - d. Removable Covers: One for blocking each different opening size when device is temporarily removed from its compartment.
  - 5. See Section 26 2813 for requirements for spare fuses and spare fuse cabinets.

#### **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of CEC.
- 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 switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.
- B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.
- C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

#### **1.08 FIELD CONDITIONS**

- A. Maintain field conditions within required service conditions during and after installation.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Substitutions: See Section 01 6000 - Product Requirements.
- B. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

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- C. Source Limitations: Furnish switchboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

## 2.02 SWITCHBOARDS

- A. Switchboard shall be provided with weatherproof enclosure suitable for outdoor location as required.
- B. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.
- E. Front-Connected Switchboards:
  - 1. Main Device(s): Individually-mounted.
  - 2. Feeder Devices: Panel/group-mounted.
  - 3. Arrangement: Front accessible only (not rear accessible), rear aligned.
  - 4. Gutter Access: Bolted covers.
- F. Service Entrance Switchboards:
  - 1. Listed and labeled as suitable for use as service equipment according to UL 869A.
  - 2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
  - 3. Comply with Utility Company requirements for electrical service.
  - 4. Utility Metering Provisions: Provide separate barriered compartment complying with Utility Company requirements where indicated or where required by Utility Company. Include hinged sealable door and provisions for Utility Company current transformers (CTs), potential transformers (PTs), or potential taps as required.
  - 5. See Section 26 2100 for additional requirements.
- G. Switchboards With Busway Transitions: Configured for bussed connection to busway provided in accordance with Section 26 2513.
- H. Switchboards With Fire Pump Taps: Provide separate bussed vertical section with suitable lugs for fire pump connection to line side of main service disconnect device(s).
- I. Switchboards With Drawout Devices: Provide integral top rail-mounted lifting device where indicated.
- J. Seismic Qualification: Provide switchboards and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.
- K. Service Conditions:
  - 1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
    - a. Altitude: Less than 6,600 feet.
    - b. Ambient Temperature:
      - 1) Switchboards Containing Molded Case or Insulated Case Circuit Breakers: Between 23 degrees F and 104 degrees F.
      - 2) Switchboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F.
  - 2. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- L. Short Circuit Current Rating:

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1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
  2. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 0573.
  3. Minimum Rating: 65,000 rms symmetrical amperes.
  4. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
  5. Label equipment utilizing series ratings as required by CEC.
- M. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- N. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.
- O. Bussing: Sized in accordance with UL 891 temperature rise requirements.
1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
  2. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
  3. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
  4. Phase and Neutral Bus Material: Aluminum.
  5. Ground Bus Material: Aluminum.
- P. Conductor Terminations: Suitable for use with the conductors to be installed.
1. Line Conductor Terminations:
    - a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
    - b. Main and Neutral Lug Type: Mechanical.
  2. Load Conductor Terminations:
    - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
    - b. Lug Type:
      - 1) Provide mechanical lugs unless otherwise indicated.
      - 2) Provide compression lugs where indicated.
- Q. Enclosures:
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1 or Type 2 (drip-proof).
    - b. Outdoor Locations: Type 3R.
  2. Finish: Manufacturer's standard unless otherwise indicated.
  3. Enclosure Space Heaters:
    - a. Size according to manufacturer's recommendations for worst case ambient temperature to prevent condensation.
    - b. Heater Control: Thermostat.
    - c. Heater Power Source: Provide connection to transformer factory-installed in switchboard or suitable external branch circuit as indicated or as required.
  4. Outdoor Enclosures:
    - a. Enclosure Type: Non-walk-in type unless otherwise indicated.
    - b. Color: Manufacturer's standard.
    - c. Access Doors: Lockable, with all locks keyed alike.
    - d. Walk-in Enclosure Features:
      - 1) Personnel Doors: Open to exterior; equipped with panic hardware.
      - 2) Aisle lighting, with switch at each access door.

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### 3) GFCI duplex convenience receptacle.

- R. Future Provisions:
  - 1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
  - 2. Equip distribution sections with full height vertical bussing to accommodate maximum utilization of space for devices.
- S. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list switchboards as a complete assembly including surge protective device.
- T. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
  - 1. Where overcurrent protective devices equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
  - 2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
    - a. Use zero sequence or residual ground fault detection method unless otherwise indicated.
    - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
    - c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.
- U. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.
- V. 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.

## 2.03 OVERCURRENT PROTECTIVE DEVICES

- A. Fusible Devices:
  - 1. Fusible Switches:
    - a. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
    - b. Fuse Clips: As required to accept indicated fuses.
      - 1) Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
    - c. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
  - 2. Fused Power-Circuit Devices:
    - a. Description: Quick-make, quick-break, dead-front bolted-pressure contact switches and high-pressure butt contact switches listed and labeled as complying with UL 977; ratings, configurations, and features as indicated on the drawings.
    - b. Bolted-Pressure Contact Switches: Devices with additional pressure or clamping action provided at both ends of switch blades when blades are in the fully closed position.
    - c. High-Pressure Butt Contact Switches: Devices with butt-type contacts and spring-charged mechanism.

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- d. Minimum Short Circuit Current Rating: 200,000 rms symmetrical amperes when protected by Class L fuses.
  - e. Fuse Clips: As required to accept Class L fuses.
  - f. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
  - g. Provide the following features and accessories where indicated or where required to complete installation:
    - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
    - 2) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating switch position.
    - 3) Blown fuse protection and indication.
- B. Circuit Breakers:
- 1. Interrupting Capacity:
    - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
    - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
    - c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
  - 2. Molded Case Circuit Breakers:
    - a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
      - 1) Provide thermal magnetic circuit breakers unless otherwise indicated.
      - 2) Provide electronic trip circuit breakers where indicated.
    - b. Minimum Interrupting Capacity:
      - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
      - 2) 14,000 rms symmetrical amperes at 480 VAC.
    - c. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
      - 1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
      - 2) Provide interchangeable trip units where indicated.
    - d. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
      - 1) Provide the following field-adjustable trip response settings:
        - (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
        - (b) Long time delay.
        - (c) Short time pickup and delay.
        - (d) Instantaneous pickup.
        - (e) Ground fault pickup and delay where ground fault protection is indicated.
      - 2) Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
      - 3) Provide communication capability where indicated: Compatible with system indicated.

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- e. Provide the following circuit breaker types where indicated:
  - 1) 100 Percent Rated Circuit Breakers: Listed for application within the switchboard where installed at 100 percent of the continuous current rating.
  - 2) Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
- f. Provide the following features and accessories where indicated or where required to complete installation:
  - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
  - 2) Pad-Lock Provision: For locking circuit breaker handle in OFF position.
  - 3) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
  - 4) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
  - 5) Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.
- 3. Insulated Case Circuit Breakers:
  - a. Description: Quick-make, quick-break, trip-free circuit breakers with two-step stored energy closing mechanism; standard 80 percent rated unless otherwise indicated; listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.
  - b. Operation:
    - 1) Provide manually operated circuit breakers unless otherwise indicated.
    - 2) Provide electrically operated circuit breakers where indicated.
    - 3) Pad-Lock Provision: For preventing circuit breaker closing operation.
  - c. Construction:
    - 1) Provide fixed-mount circuit breakers unless otherwise indicated.
    - 2) Provide drawout circuit breakers where indicated.
  - d. Drawout Circuit Breakers:
    - 1) Allows withdrawal of circuit breaker into test and disconnected positions, with racking position indication (connected, test, disconnected, withdrawn).
    - 2) Provide safety interlock to prevent racking of circuit breaker while in the ON position.
    - 3) Pad-Lock Provision: For preventing circuit breaker drawout operation.
  - e. Minimum Interrupting Capacity:
    - 1) 42,000 rms symmetrical amperes at 240 VAC or 208 VAC.
    - 2) 65,000 rms symmetrical amperes at 480 VAC.
  - f. Trip Units: Solid state, microprocessor-based, true rms sensing.
    - 1) Provide the following field-adjustable trip response settings:
      - (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
      - (b) Long time delay.
      - (c) Short time pickup and delay.
      - (d) Instantaneous pickup.
      - (e) Ground fault pickup and delay where ground fault protection is indicated.
    - 2) Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
    - 3) Provide communication capability where indicated: Compatible with system indicated.
  - g. Provide the following circuit breaker types where indicated:

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- 1) Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
- h. Provide the following features and accessories where indicated or where required to complete installation:
  - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
  - 2) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
  - 3) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
  - 4) Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.

## 2.04 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:
  1. Dielectric tests.
  2. Mechanical operation tests.
  3. Grounding of instrument transformer cases test.
  4. Electrical operation and control wiring tests, including polarity and sequence tests.
  5. Ground-fault sensing equipment test.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive switchboards.
- 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 switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.
- C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.
- D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch between switchboard and wall.
- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Provide required seismic controls in accordance with Section 26 0548.
- G. Install switchboards plumb and level.
- H. Unless otherwise indicated, mount switchboards on properly sized 4 inch high concrete pad constructed in accordance with Section 03 3000.
- I. Provide grounding and bonding in accordance with Section 26 0526.
- J. Install all field-installed devices, components, and accessories.
- K. Provide fuses complying with Section 26 2813 for fusible switches as indicated.

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- L. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- M. Set field-adjustable circuit breaker tripping function settings as indicated.
- N. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- O. Provide filler plates to cover unused spaces in switchboards.
- P. Identify switchboards in accordance with Section 26 0553.

### 3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - 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 reports with submittals.
- C. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- D. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.
- E. Inspect and test in accordance with NETA ATS, except Section 4.
- F. Perform inspections and tests listed in NETA ATS, Section 7.1.
- G. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- H. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than [ ] amperes. Tests listed as optional are not required.
- I. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
  - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
- J. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.
- K. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.
- L. Test shunt trips to verify proper operation.
- M. Correct deficiencies and replace damaged or defective switchboards or associated components.
- N. Submit detailed reports indicating inspection and testing results and corrective actions taken.

### 3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of switchboard covers and doors.

### 3.05 CLEANING

- A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.
- B. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.
- C. Repair scratched or marred surfaces to match original factory finish.

### 3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.

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- C. Training: Train Owner's personnel on operation, adjustment, and maintenance of switchboard 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 switchboards from subsequent construction operations.

**END OF SECTION 26 2413**

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## SECTION 26 2416 PANELBOARDS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

#### 1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
  - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- G. Section 26 2200 - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.
- H. Section 26 2813 - Fuses: Fuses for fusible switches and spare fuse cabinets.
- I. Section 26 4300 - Surge Protective Devices.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- D. NECA 407 - Standard for Installing and Maintaining Panelboards.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.
- G. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).
- H. NEMA PB 1 - Panelboards.
- I. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- K. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- L. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- M. UL 67 - Panelboards.
- N. UL 98 - Enclosed and Dead-Front Switches.
- O. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
- P. UL 869A - Reference Standard for Service Equipment.
- Q. UL 943 - Ground-Fault Circuit-Interrupters.
- R. UL 1053 - Ground-Fault Sensing and Relaying Equipment.

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S. UL 1699 - Arc-Fault Circuit-Interrupters.

#### 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 the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
  2. Include wiring diagrams showing all factory and field connections.
  3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
  4. Include documentation of listed series ratings upon request.
  5. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.
- 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 locations of panelboards and actual installed circuiting arrangements.
- I. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Section 01 6000 - Product Requirements, for additional provisions.
  2. Panelboard Keys: Two of each different key.

#### 1.06 QUALITY ASSURANCE

- A. Conform to requirements of CEC.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

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- 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 panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

#### **1.08 FIELD CONDITIONS**

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
  - 1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. ABB/GE: [www.geindustrial.com/#sle](http://www.geindustrial.com/#sle).
- B. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
- C. Schneider Electric; Square D Products: [www.schneider-electric.us/#sle](http://www.schneider-electric.us/#sle).
- D. Siemens Industry, Inc: [www.usa.siemens.com/#sle](http://www.usa.siemens.com/#sle).
- E. Substitutions: See Section 01 6000 - Product Requirements.
- F. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

#### **2.02 PANELBOARDS - GENERAL REQUIREMENTS**

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Seismic Qualification: Provide panelboards and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
  - 1. Altitude: Less than 6,600 feet.
  - 2. Ambient Temperature:
    - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- D. Short Circuit Current Rating:
  - 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- E. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- F. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- G. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- H. Bussing: Sized in accordance with UL 67 temperature rise requirements.

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1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
  2. Provide 200 percent rated neutral bus and lugs where indicated, where oversized neutral conductors are provided, or where panelboards are fed from K-rated transformers.
  3. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
  4. Provide separate isolated/insulated ground bus where indicated or where isolated grounding conductors are provided.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
- J. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1.
    - b. Outdoor Locations: Type 3R.
  2. Boxes: Galvanized steel unless otherwise indicated.
    - a. Provide wiring gutters sized to accommodate the conductors to be installed.
    - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
    - c. Provide removable end walls for NEMA Type 1 enclosures.
    - d. Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.
  3. Fronts:
    - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
    - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
    - c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
  4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- K. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- L. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list and label panelboards as a complete assembly including surge protective device.
- M. Panelboard Contactors: Where panelboard contactors are indicated, provide electrically operated, mechanically held magnetic contactor complying with NEMA ICS 2.
1. Ampere Rating: Not less than ampere rating of panelboard bus.
  2. Short Circuit Current Rating: Not less than the panelboard short circuit current rating.
  3. Coil Voltage: As required for connection to control system indicated.
- N. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
  2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
    - a. Use zero sequence ground fault detection method unless otherwise indicated.
    - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
- O. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- P. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

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- Q. Provide the following features and accessories where indicated or where required to complete installation:
1. Feed-through lugs.
  2. Sub-feed lugs.

### **2.03 POWER DISTRIBUTION PANELBOARDS**

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
  2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
1. Phase and Neutral Bus Material: Aluminum.
  2. Ground Bus Material: Aluminum.
- D. Circuit Breakers:
1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.
  2. Provide thermal magnetic circuit breakers unless otherwise indicated.
  3. Provide electronic trip circuit breakers where indicated.
- E. Enclosures:
1. Provide surface-mounted enclosures unless otherwise indicated.
  2. Fronts: Provide trims to cover access to load terminals, wiring gutters, and other live parts, with exposed access to overcurrent protective device handles.
  3. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
  4. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
  5. Provide clear plastic circuit directory holder mounted on inside of door.

### **2.04 LIGHTING AND APPLIANCE PANELBOARDS**

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
  2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
  2. Phase and Neutral Bus Material: Aluminum.
  3. Ground Bus Material: Aluminum.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Enclosures:
1. Provide surface-mounted or flush-mounted enclosures as indicated.
  2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
  3. Provide clear plastic circuit directory holder mounted on inside of door.

### **2.05 OVERCURRENT PROTECTIVE DEVICES**

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A. Fusible Switches:

1. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
2. Fuse Clips: As required to accept indicated fuses.
3. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
4. Conductor Terminations:
  - a. Provide compression lugs unless otherwise indicated.
  - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

B. Molded Case Circuit Breakers:

1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
  - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
    - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
    - 2) 14,000 rms symmetrical amperes at 480 VAC.
  - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
  - a. Provide compression lugs unless otherwise indicated.
  - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
  - a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
  - b. Provide interchangeable trip units where indicated.
5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
  - a. Provide the following field-adjustable trip response settings:
    - 1) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
    - 2) Long time delay.
    - 3) Short time pickup and delay.
    - 4) Instantaneous pickup.
    - 5) Ground fault pickup and delay where ground fault protection is indicated.
  - b. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
  - c. Provide communication capability where indicated: Compatible with system indicated.
6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
7. Provide the following circuit breaker types where indicated:
  - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
  - b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.

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- c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
- d. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
- e. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
- 8. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
- 9. Provide listed high intensity discharge lighting rated circuit breakers with HID marking for all branch circuits serving HID lighting.
- 10. Do not use tandem circuit breakers.
- 11. Do not use handle ties in lieu of multi-pole circuit breakers.
- 12. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
- 13. Provide the following features and accessories where indicated or where required to complete installation:
  - a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
  - b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.
  - c. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
  - d. Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
  - e. Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.

## 2.06 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Factory test panelboards according to NEMA PB 1.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- 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. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and CEC.
- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Install panelboards plumb.
- G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- I. Mount floor-mounted power distribution panelboards on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.

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- J. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- K. Provide grounding and bonding in accordance with Section 26 0526.
  - 1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
  - 2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.
- L. Install all field-installed branch devices, components, and accessories.
- M. Provide fuses complying with Section 26 2813 for fusible switches as indicated.
- N. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- O. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by CEC.
- P. Set field-adjustable circuit breaker tripping function settings as indicated.
- Q. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 0573.
- R. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- S. Provide filler plates to cover unused spaces in panelboards.
- T. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
  - 1. Emergency and night lighting circuits.
  - 2. Fire detection and alarm circuits.
  - 3. Communications equipment circuits.
  - 4. Intrusion detection and access control system circuits.
  - 5. Video surveillance system circuits.
- U. Identify panelboards in accordance with Section 26 0553.

### 3.03 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- D. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than [ ] amperes. Tests listed as optional are not required.
  - 1. Perform insulation-resistance tests on all control wiring with respect to ground.
  - 2. Test functions of the trip unit by means of secondary injection.
- E. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by CEC.
- F. Test GFCI circuit breakers to verify proper operation.
- G. Test AFCI circuit breakers to verify proper operation.
- H. Test shunt trips to verify proper operation.
- I. 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.
- J. Correct deficiencies and replace damaged or defective panelboards or associated components.

### 3.04 ADJUSTING

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- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

### **3.05 CLEANING**

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

**END OF SECTION 26 2416**

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## SECTION 26 2419 MOTOR-CONTROL CENTERS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Low-voltage (600 V and less) standard (non-arc-resistant) NEMA motor control centers.
- B. Low-voltage (600 V and less) arc-resistant NEMA motor control centers.
- C. Motor control center units:
  - 1. Feeder units.
  - 2. Combination magnetic motor starter units.
- D. Overcurrent protective devices for motor control centers and associated units, including overload relays.
- E. Motor control accessories:
  - 1. Auxiliary contacts.
  - 2. Pilot devices.
  - 3. Control and timing relays.
  - 4. Control power transformers.
  - 5. Control terminal blocks.

#### 1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- G. Section 26 2100 - Low-Voltage Electrical Service Entrance.
  - 1. Includes Utility Company contact information.
- H. Section 26 2200 - Low-Voltage Transformers: For integration into equipment specified in this section, where indicated.
- I. Section 26 2416 - Panelboards: For integration into equipment specified in this section, where indicated.
- J. Section 26 2813 - Fuses: Fuses for fusible switches.
  - 1. Includes requirements for spare fuses and spare fuse cabinets.
- K. Section 26 2923 - Variable-Frequency Motor Controllers.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
- C. IEEE C37.20.7 - IEEE Guide for Testing Switchgear Rated up to 52 kV for Internal Arcing Faults.
- D. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- F. NECA 402 - Standard for Installing and Maintaining Motor Control Centers.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

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- H. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.
- I. NEMA ICS 2.3 - Industrial Control and Systems: Instructions for the Handling, Installation, Operation, and Maintenance of MCCs Rated Not More Than 600 Volts.
- J. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
- K. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
- L. NEMA ICS 18 - Motor Control Centers.
- M. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).
- N. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- O. UL 98 - Enclosed and Dead-Front Switches.
- P. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
- Q. UL 845 - Motor Control Centers.
- R. UL 869A - Reference Standard for Service Equipment.
- S. UL 977 - Fused Power-Circuit Devices.
- T. UL 1053 - Ground-Fault Sensing and Relaying Equipment.

#### **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 required by CEC.
  - 2. Coordinate the work to provide motor controllers and associated overload relays suitable for use with the actual motors to be installed.
  - 3. Coordinate the work to provide motor controllers and associated wiring suitable for interface with control devices to be installed.
  - 4. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 5. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 6. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
  - 7. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Service Entrance Motor Control Centers:
  - 1. Coordinate with Utility Company to provide motor control centers with suitable provisions for electrical service.
  - 2. See Section 26 2100 for Utility Company contact information and additional requirements.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor control centers, enclosures, units, overcurrent protective devices, and other installed components and accessories.
  - 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
  - 2. Arc-Resistant Motor Control Centers: Indicate IEEE C37.20.7 accessibility type, and maximum fault current and arc duration.

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- C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, unit arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  - 1. Include dimensioned plan and elevation views of motor control centers and adjacent equipment with all required clearances indicated.
  - 2. Include wiring diagrams showing all factory and field connections.
  - 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
  - 4. Include documentation of listed series ratings upon request.
  - 5. Include documentation demonstrating selective coordination upon request.
  - 6. Arc-Resistant Motor Control Centers: Include proposed plenum arrangement, where applicable.
  - 7. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- 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, and installation of product.
- F. Field Quality Control Test Reports.
- G. Project Record Documents: Record actual installed locations of motor control centers and final equipment settings.
  - 1. Include nameplate data of actual installed motors and associated overload relay selections and settings.
  - 2. Motor Circuit Protectors: Include magnetic instantaneous trip settings.
- H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Enclosure Keys: Two of each different key.
  - 3. Electronic Trip Circuit Breakers: Provide one portable test set.
  - 4. Indicating Lights: Two of each different type.
  - 5. See Section 26 2813 for requirements for spare fuses and spare fuse cabinets.

#### **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of CEC.
- 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 motor control centers in accordance with manufacturer's instructions, NECA 402, and NEMA ICS 2.3.
- B. Store in a clean, dry space having a uniform temperature to prevent condensation. Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.
- C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle carefully to avoid damage to internal components, enclosure, and finish.

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## 1.08 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

### 2.02 MOTOR CONTROL CENTER UNITS

- A. Feeder Units: Circuit breaker type.
- B. Combination Magnetic Motor Starter Units:
1. Description: NEMA ICS 2, Class A combination motor controllers with magnetic contactor(s), externally operable disconnect and overload relay(s).
  2. Configuration: Full-voltage non-reversing type unless otherwise indicated.
  3. Use of non-standard starter sizes smaller than specified standard NEMA sizes is not permitted.
  4. Disconnects: Circuit breaker type.
    - a. Circuit Breakers: Motor circuit protectors (magnetic-only) unless otherwise indicated or required.
    - b. Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect in the ON position with capability of overriding interlock for testing purposes.
    - c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
  5. Overload Relays: Bimetallic thermal type unless otherwise indicated.
  6. Pilot Devices Required:
    - a. Furnish local pilot devices for each unit as specified below unless otherwise indicated on drawings.
    - b. Single-Speed, Non-Reversing Starters:
      - 1) Pushbuttons: START-STOP.
      - 2) Selector Switches: HAND/OFF/AUTO.
      - 3) Indicating Lights: Red ON, Green OFF.
    - c. Single-Speed, Reversing Starters:
      - 1) Pushbuttons: FOR-REV-STOP.
      - 2) Selector Switches: FOR/OFF/REV.
      - 3) Indicating Lights: Red FOR, Red REV, Green OFF.
    - d. Two-Speed Starters:
      - 1) Pushbuttons: FAST-OFF-SLOW.
      - 2) Selector Switches: SLOW/OFF/FAST.
      - 3) Indicating Lights: Red FAST, Red SLOW, Green OFF.
- C. Variable-Frequency AC Drive Units: Comply with Section 26 2923.
- D. Distribution Equipment Units: Where incorporation of low-voltage distribution equipment within motor control center units is indicated, provide suitable components complying with applicable specified requirements.
1. Low-Voltage Transformers: See Section 26 2200.
  2. Panelboards: See Section 26 2416.

### 2.03 OVERCURRENT PROTECTIVE DEVICES

- A. Overload Relays:

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1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and CEC; include consideration for motor service factor and ambient temperature correction, where applicable.
  2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
  3. Trip-free operation.
  4. Visible trip indication.
  5. Resettable.
    - a. Employ manual reset unless otherwise indicated.
    - b. Employ automatic reset or remote reset where indicated.
    - c. Do not employ automatic reset with two-wire control.
  6. Bimetallic Thermal Overload Relays:
    - a. Provide ambient temperature compensation.
    - b. Interchangeable current elements/heaters.
    - c. Adjustable trip; plus/minus 10 percent of nominal, minimum.
    - d. Designed for quicker trip response under phase loss condition.
    - e. Trip test function.
    - f. Provide isolated alarm contact where indicated.
  7. Melting Alloy Thermal Overload Relays:
    - a. Interchangeable current elements/heaters.
    - b. Provide isolated alarm contact where indicated.
  8. Solid-State Overload Relays:
    - a. Selectable inverse-time trip class rating; available ratings of Class 10, 20, and 30, minimum.
    - b. Adjustable full load current.
    - c. Phase loss protection.
    - d. Phase imbalance protection.
    - e. Ground fault protection.
    - f. Ambient temperature insensitive.
    - g. Thermal memory.
    - h. Repeat Trip Accuracy: Plus/minus 2 percent, minimum.
    - i. Trip test function.
    - j. Provide isolated alarm contact.
    - k. Provide communication capability where indicated: Compatible with system indicated.
- B. Fusible Devices:
1. Fusible Switches:
    - a. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
    - b. Fuse Clips: As required to accept indicated fuses.
      - 1) Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
    - c. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
  2. Fused Power-Circuit Devices:
    - a. Description: Quick-make, quick-break, dead-front bolted-pressure contact switches and high-pressure butt contact switches listed and labeled as complying with UL 977; ratings, configurations, and features as indicated on the drawings.

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- b. Bolted-Pressure Contact Switches: Devices with additional pressure or clamping action provided at both ends of switch blades when blades are in the fully closed position.
  - c. High-Pressure Butt Contact Switches: Devices with butt-type contacts and spring-charged mechanism.
  - d. Minimum Short Circuit Current Rating: 200,000 rms symmetrical amperes when protected by Class L fuses.
  - e. Fuse Clips: As required to accept Class L fuses.
  - f. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
  - g. Provide the following features and accessories where indicated or where required to complete installation:
    - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
    - 2) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating switch position.
    - 3) Blown fuse protection and indication.
- C. Circuit Breakers:
  - 1. Interrupting Capacity (not applicable to motor circuit protectors):
    - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
    - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
  - 2. Motor Circuit Protectors:
    - a. Description: Instantaneous-trip circuit breakers furnished with magnetic instantaneous tripping elements for short circuit protection, but not with thermal inverse time tripping elements for overload protection; UL 489 recognized only for use as part of a listed combination motor controller with overload protection; ratings, configurations, and features as indicated on the drawings.
    - b. Provide field-adjustable magnetic instantaneous trip setting.
    - c. Provide the following features and accessories where indicated or where required to complete installation:
      - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
      - 2) Pad-Lock Provision: For locking circuit breaker handle in OFF position.
      - 3) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
      - 4) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
      - 5) Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.
  - 3. Molded Case Circuit Breakers:
    - a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
      - 1) Provide thermal magnetic circuit breakers unless otherwise indicated.
      - 2) Provide electronic trip circuit breakers where indicated.
    - b. Minimum Interrupting Capacity:
      - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
      - 2) 14,000 rms symmetrical amperes at 480 VAC.

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- c. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
  - 1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
  - 2) Provide interchangeable trip units where indicated.
- d. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
  - 1) Provide the following field-adjustable trip response settings:
    - (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
    - (b) Long time delay.
    - (c) Short time pickup and delay.
    - (d) Instantaneous pickup.
    - (e) Ground fault pickup and delay where ground fault protection is indicated.
  - 2) Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
  - 3) Provide communication capability where indicated: Compatible with system indicated.
- e. Provide the following circuit breaker types where indicated:
  - 1) 100 Percent Rated Circuit Breakers: Listed for application within the motor control center where installed at 100 percent of the continuous current rating.
  - 2) Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
- f. Provide the following features and accessories where indicated or where required to complete installation:
  - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
  - 2) Pad-Lock Provision: For locking circuit breaker handle in OFF position.
  - 3) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
  - 4) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
  - 5) Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.
- 4. Insulated Case Circuit Breakers:
  - a. Description: Quick-make, quick-break, trip-free circuit breakers with two-step stored energy closing mechanism; standard 80 percent rated unless otherwise indicated; listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.
  - b. Operation:
    - 1) Provide manually operated circuit breakers unless otherwise indicated.
    - 2) Provide electrically operated circuit breakers where indicated.
    - 3) Pad-Lock Provision: For preventing circuit breaker closing operation.
  - c. Construction:
    - 1) Provide fixed-mount circuit breakers unless otherwise indicated.
    - 2) Provide drawout circuit breakers where indicated.
  - d. Drawout Circuit Breakers:
    - 1) Allows withdrawal of circuit breaker into test and disconnected positions, with racking position indication (connected, test, disconnected, withdrawn).

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- 2) Provide safety interlock to prevent racking of circuit breaker while in the ON position.
- 3) Pad-Lock Provision: For preventing circuit breaker drawout operation.
- e. Minimum Interrupting Capacity:
  - 1) 42,000 rms symmetrical amperes at 240 VAC or 208 VAC.
  - 2) 65,000 rms symmetrical amperes at 480 VAC.
- f. Trip Units: Solid state, microprocessor-based, true rms sensing.
  - 1) Provide the following field-adjustable trip response settings:
    - (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
    - (b) Long time delay.
    - (c) Short time pickup and delay.
    - (d) Instantaneous pickup.
    - (e) Ground fault pickup and delay where ground fault protection is indicated.
  - 2) Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
  - 3) Provide communication capability where indicated: Compatible with system indicated.
- g. Provide the following circuit breaker types where indicated:
  - 1) 100 Percent Rated Circuit Breakers: Listed for application within the switchboard where installed at 100 percent of the continuous current rating.
  - 2) Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
- h. Provide the following features and accessories where indicated or where required to complete installation:
  - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
  - 2) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
  - 3) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
  - 4) Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.
  - 5) Truck-Operated Cell Switch: For indicating circuit breaker racking position.

## 2.04 MOTOR CONTROL 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 starter unit, minimum.
- B. Pilot Devices:
  1. Comply with NEMA ICS 5; heavy-duty type.
  2. Nominal Size: 30 mm.
  3. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
  4. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
  5. Indicating Lights: Push-to-test type unless otherwise indicated.
  6. Provide LED lamp source for indicating lights and illuminated devices.

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- C. Control and Timing Relays:
  - 1. Comply with NEMA ICS 5.
  - 2. Provide number and type of relays indicated or required to perform necessary functions.
  - 3. Timing Relays: Electronic or pneumatic as indicated.
    - a. Adjustable Timing Range: As indicated on drawings.
  - 4. Multi-Speed Motor Starters: Employ accelerating relays, decelerating relays, and compelling relays where indicated.
  - 5. Accelerating Relays: Starts motor at low speed and then accelerates automatically through definite time intervals for each successive speed until selected speed is attained.
  - 6. Decelerating Relays: Allows motor to decelerate automatically through definite time intervals for each successive speed until selected speed is attained.
  - 7. Compelling Relays: Requires motor to start at low speed before a higher speed can be selected.
- D. Control Power Transformers:
  - 1. Size to accommodate burden of contactor coil(s) and all connected auxiliary devices, plus [ ] VA spare capacity.
  - 2. Include primary and secondary fuses.
- E. Control Terminal Blocks: Include 25 percent spare terminals.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the motor control centers and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive motor control centers.
- 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 motor control centers in accordance with NECA 1 (general workmanship), NECA 402, and NEMA ICS 2.3.
- C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Install motor control centers plumb and level.
- F. Unless otherwise indicated, mount motor control centers on properly sized 4 inch high concrete pad constructed in accordance with Section 03 3000.
- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Install all field-installed devices, components, and accessories.
- I. Provide fuses complying with Section 26 2813 for fusible switches as indicated.
- J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- K. Set field-adjustable motor controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and CEC.
- L. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed in accordance with Section 26 0573.
- M. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- N. Provide filler plates to cover unused spaces.

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- O. Identify motor control centers in accordance with Section 26 0553.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- C. Before energizing motor control center, perform insulation resistance testing in accordance with NECA 402 and NEMA ICS 2.3.
- D. Inspect and test in accordance with NETA ATS, except Section 4.
- E. Perform inspections and tests listed in NETA ATS, Section 7.16.2.1.
- F. Motor Starters: Perform inspections and tests listed in NETA ATS, Section 7.16.1.1. Tests listed as optional are not required.
- G. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- H. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1. Tests listed as optional are not required.
- I. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
  - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
- J. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.
- K. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.
- L. Test shunt trips to verify proper operation.
- M. Correct deficiencies and replace damaged or defective motor control centers or associated components.

### **3.04 ADJUSTING**

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of motor control center covers and doors.

### **3.05 CLEANING**

- A. Clean dirt and debris from motor control center enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred surfaces to match original factory finish.

### **3.06 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of motor controllers to Owner, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, and maintenance of motor control center 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.

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### **3.07 PROTECTION**

- A. Protect installed motor control centers from subsequent construction operations.

**END OF SECTION 26 2419**

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## SECTION 26 2713 ELECTRICITY METERING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Equipment for Owner electricity metering:
  - 1. Single circuit electricity meters.
  - 2. Multi-circuit electricity meters.

#### 1.02 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0533.16 - Boxes for Electrical Systems: Cabinets and enclosures for metering system components.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 2100 - Low-Voltage Electrical Service Entrance: Requirements for Utility Company electricity metering.
- F. Section 26 2300 - Low-Voltage Switchgear: For interface with meters specified in this section.
- G. Section 26 2413 - Switchboards: For interface with meters specified in this section.
- H. Section 26 2416 - Panelboards: For interface with meters specified in this section.
- I. Section 26 2419 - Motor-Control Centers: For interface with meters specified in this section.
- J. Section 26 2813 - Fuses.
  - 1. Includes requirements for spare fuses and spare fuse cabinets.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. ANSI C12.1 - Electric Meters - Code for Electricity Metering.
- C. ANSI C12.20 - American National Standard for Electricity Meters - 0.1, 0.2, and 0.5 Accuracy Classes.
- D. IEC 62053-21 - Electricity Metering Equipment - Particular Requirements - Part 21: Static Meters for AC Active Energy (Classes 0,5, 1 and 2).
- E. IEC 62053-22 - Electricity Metering Equipment - Particular Requirements - Part 22: Static Meters for AC Active Energy (Classes 0,1S,0,2S and 0,5S).
- F. IEC 62053-23 - Electricity Metering Equipment - Particular Requirements - Part 23: Static Meters for Reactive Energy (Classes 2 and 3).
- G. IEEE 1459 - IEEE Standard Definitions for the Measurement of Electric Power Quantities Under Sinusoidal, Nonsinusoidal, Balanced, or Unbalanced Conditions.
- H. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers.
- I. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- J. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- K. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate work to provide equipment suitable for interface with electricity metering systems to be provided.
  - 2. Coordinate the work with other installers to provide communication lines required for electricity metering system interface.

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3. 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 electricity metering system interface requirements.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. 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.
- C. Shop Drawings: Include system interconnection schematic diagrams showing all factory and field connections. Include requirements for interface with other systems.
- 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. Field Quality Control Test Reports.
- F. Project Record Documents: Record actual installed locations of meters and final equipment settings.
- G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Section 01 6000 - Product Requirements, for additional provisions.
  2. Enclosure Keys: Two of each different key.
  3. See Section 26 2813 for requirements for spare fuses and spare fuse cabinets.

#### **1.06 QUALITY ASSURANCE**

- A. Comply with requirements of CEC.
- 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.
- B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

#### **1.08 FIELD CONDITIONS**

- A. Maintain field conditions within required service conditions during and after installation.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Electricity Meters - Basis of Design: Veris Industries as indicated under product description below;
- B. Electricity Meters - Other Acceptable Manufacturers:
  1. Veris Industries; E5x Series Enhanced Power and Energy Meter:
  2. Same as manufacturer of electrical distribution equipment used for this project.
    - a. ABB/GE: [www.geindustrial.com/#sle](http://www.geindustrial.com/#sle).

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- b. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
  - c. Schneider Electric; Square D Products: [www.schneider-electric.us/#sle](http://www.schneider-electric.us/#sle).
  - d. Siemens Industry, Inc: [www.usa.siemens.com/#sle](http://www.usa.siemens.com/#sle).
- C. Substitutions: See Section 01 6000 - Product Requirements.
- D. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.
- E. Source Limitations: Furnish electricity meters produced by a single manufacturer and obtained from a single supplier.

## 2.02 EQUIPMENT FOR OWNER ELECTRICITY METERING

- A. Provide microprocessor-based digital electricity metering systems including all instrument transformers, wiring, and connections necessary for measurements specified.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Provide electricity metering systems and associated components compatible with the equipment and associated circuits to be metered.
- D. Service Conditions: Provide electricity meters suitable for operation under the service conditions at the installed location.
- E. Enclosures:
  - 1. Where not furnished by manufacturer, provide required cabinets and enclosures in accordance with Section 26 0533.16.
  - 2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1.
    - b. Outdoor Locations: Type 3R or Type 4.
  - 3. Provide lockable door(s) for outdoor locations.
  - 4. Finish: Manufacturer's standard unless otherwise indicated.
- F. Instrument Transformers:
  - 1. Comply with IEEE C57.13, where applicable.
  - 2. Select suitable ratio, burden, and accuracy as required for connected devices.
  - 3. Current Transformers: Compatible with connected meters; replace meters damaged by connection of incompatible current transformers. Provide shorting terminal blocks for connection of secondaries where applicable.
  - 4. Potential Transformers: Include primary and secondary fuses with disconnecting means.
- G. Interface with Other Work:
  - 1. Interface with electrical power monitoring system.
  - 2. Interface with building automation system.

## 2.03 SINGLE CIRCUIT ELECTRICITY METERS

- A. Single Circuit Electricity Meter - Basis of Design: Veris Industries; E5x Series Enhanced Power and Energy Meter with LCD screen interface; 5-year warranty; utilizes voltage mode CTs that do not require terminal shorting blocks; compatible with solid-core, split-core, and rope CTs.
  - 1. Accuracy:
    - a. Real/Active Power/Energy: Revenue grade; plus/minus 0.2 percent, complying with ANSI C12.20 accuracy and IEC 62053-22, Class 0.2S.
    - b. Reactive Power/Energy: Plus/minus 2.0 percent, complying with IEC 62053-23, Class 2.
  - 2. Measured Parameters:
    - a. Real/active energy (kWh); per phase and total of all phases.
    - b. Reactive energy (kVARh) and apparent energy (kVAh); total of all phases.

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- c. Net present demand over a user-specified interval (block or sliding window); real/active power (kW), reactive power (kVAR), and apparent power (kVA).
- d. Maximum (peak) demand intervals; real/active power (kW), reactive power (kVAR), and apparent power (kVA).
- e. Real/active power (kW), reactive power (kVAR), and apparent power (kVA); per phase and total of all phases.
- f. Models Available with Bi-directional Energy Measurements:
  - 1) Real/active energy (kWh) and apparent energy (kVAh); imported (from the grid), exported (to the grid), and signed net total.
  - 2) Reactive energy (kVARh); imported (from the grid) and exported (to the grid), per quadrant as defined by IEEE 1459.
  - 3) Maximum demand; real/active power (kW), reactive power (kVAR), and apparent power (kVA); imported (from the grid) and exported (to the grid).
- g. Current; per phase and average of all phases.
- h. Voltage; line-to-line and line-to-neutral; per phase and average of all phases.
- i. Power factor; per phase and average of all phases.
- j. Frequency.
- 3. Models Available with Data Logging: Logs and retains in non-volatile memory up to 5760 measurement records at time intervals determined by Demand Interval duration setting (up to 60 days of readings at 15 minute intervals).
- 4. Alarm capability, with configurable setpoints.
  - a. Low power factor.
  - b. Current over range.
  - c. Voltage over range.
  - d. Frequency out of range.
  - e. Models available with pulse output overrun.
- 5. Models Available with Pulse Contact Accumulator Input(s): Up to two; user-configurable to support measurement of other related energy values (gas, water, steam, etc.) using pulse-output transducers.
- 6. Outputs:
  - a. Models Available with Phase Loss Alarm Output: One; user-configurable phase loss threshold.
  - b. Models Available with Pulse Output(s): Up to two.
- 7. Communications: Compatible with connected systems. Provide all accessories necessary for proper interface.
  - a. Models available with Serial Communications:
    - 1) RS-485, 2-wire; support for Modbus RTU protocol.
    - 2) RS-485, 2-wire; support for BACnet MS/TP protocol.
    - 3) LON FT, 2-wire; support for LonTalk protocol.

## 2.04 MULTI-CIRCUIT ELECTRICITY METERS

- A. Multi-Circuit Electricity Meter - Basis of Design: Veris Industries; E3x Series Panelboard Monitoring System; 5-year warranty; utilizes voltage mode CTs that do not require shorting terminal blocks.
  - 1. Metering Capacity: As indicated or as required for circuits to be monitored (configurations available for monitoring up to 84 branch circuits, two 3-phase main devices, and two neutrals with one meter).
  - 2. Accuracy:
    - a. Real/Active Power/Energy (for models that measure this parameter): Revenue grade; plus/minus 1.0 percent (including branch CTs); complying with ANSI C12.1 and IEC 62053-21, Class 1.
    - b. Voltage (for models that measure this parameter): Plus/minus 0.5 percent.
    - c. Current: Plus/minus 0.5 percent.
  - 3. Measured Parameters at Main Device:

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- a. Current; per phase and average of all phases.
- b. Maximum current; per phase and maximum average of all phases.
- c. Current demand; per phase and average of all phases.
- d. Maximum current demand; per phase and maximum average of all phases.
- e. Models available with measurements for:
  - 1) Current phase angle.
  - 2) Real/active energy (kWh); per phase and total of all phases.
  - 3) Snapshot of total energy as of the completion of the most recent demand interval; per phase and total of all phases.
  - 4) Real/active power (kW); per phase and total of all phases; available signed to indicate whether energy is being imported or exported.
  - 5) Apparent power (kVA); per phase and total of all phases.
  - 6) Power factor; per phase and total, based on three-phase breaker rotation, signed, to indicate leading or lagging current.
  - 7) Voltage, line-to-line and line-to neutral; per phase and average of all phases.
  - 8) Voltage phase angle.
  - 9) Frequency; phase A.
4. Measured Parameters at Branch Circuits:
  - a. Current; per branch and average of all phases for multi-phase logical circuits.
  - b. Maximum current; per branch and maximum average of all phases for multi-phase logical circuits.
  - c. Current demand; per branch and average of all phases for multi-phase logical circuits.
  - d. Maximum current demand; per branch and maximum average of all phases for multi-phase logical circuits.
  - e. Models available with measurements for:
    - 1) Current phase angle.
    - 2) Real/active power (kW); per branch and total of all phases for multi-phase logical circuits; available signed to indicate whether energy is being imported or exported.
    - 3) Real/active power (kW) demand; per branch and total of all phases for multi-phase logical circuits.
    - 4) Real/active power (kW) demand maximum; per branch and total of all phases for multi-phase logical circuits.
    - 5) Real/active energy (kWh); per branch and total of all phases for multi-phase logical circuits.
    - 6) Snapshot of total energy as of the completion of the most recent demand interval; per branch and total of all phases for multi-phase logical circuits.
    - 7) Apparent power (kVA); per branch and total of all phases for multi-phase logical circuits.
    - 8) Power factor; per branch and average of all phases for multi-phase logical circuits, signed to indicate leading or lagging current.
5. Alarm capability, with configurable setpoints.
  - a. Current over/under range.
  - b. Models available with voltage over/under range.
6. Communications: Compatible with connected systems. Provide all accessories necessary for proper interface.
  - a. Models Available with Serial Communications:
    - 1) RS-485, 2-wire or 4-wire; support for Modbus RTU protocol.
    - 2) RS-485, 2-wire; support for Modbus RTU and BACnet MS/TP protocols.
  - b. Models Available with Ethernet Communications:
    - 1) Without RJ-45 10/100 Mbit; requires Modbus TCP Gateway; support for Modbus TCP protocol.

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- 2) With RJ-45 10/100 Mbit; support for Modbus TCP, BACnet IP, and SNMP protocols.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of metering systems and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive meters.
- 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. Install products in accordance with manufacturer's instructions.
- C. Provide required support and attachment components in accordance with Section 26 0529.
- D. Provide grounding and bonding in accordance with Section 26 0526.
- E. Provide fuses complying with Section 26 2813 as required.
- F. Identify meters and associated wiring in accordance with Section 26 0553.

#### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.
- D. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.
- E. Correct deficiencies and replace damaged or defective metering system components.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

#### **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. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. 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 two 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 26 2713**

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## SECTION 26 2726 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.
- H. Access floor boxes.

#### 1.02 RELATED REQUIREMENTS

- A. Section 09 6900 - Access Flooring.
- B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.
- C. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- D. Section 26 0533.16 - Boxes for Electrical Systems.
- E. Section 26 0533.23 - Surface Raceways for Electrical Systems: Surface raceway systems, including multioutlet assemblies.
- F. Section 26 0539 - Underfloor Raceways for Electrical Systems.
- G. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 26 0583 - Wiring Connections: Cords and plugs for equipment.
- I. Section 26 0923 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.
- J. Section 27 1000 - Structured Cabling: Voice and data jacks.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. FS W-C-596 - Connector, Electrical, Power, General Specification for.
- C. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification).
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- E. NECA 130 - Standard for Installing and Maintaining Wiring Devices.
- F. NEMA WD 1 - General Color Requirements for Wiring Devices.
- G. NEMA WD 6 - Wiring Devices - Dimensional Specifications.
- H. UL 20 - General-Use Snap Switches.
- I. UL 498 - Attachment Plugs and Receptacles.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices.
- K. UL 943 - Ground-Fault Circuit-Interrupters.
- L. UL 1449 - Standard for Surge Protective Devices.
- M. UL 1472 - Solid-State Dimming Controls.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

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- 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 the 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 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
  - 1. Wall Dimmers: Include derating information for ganged multiple devices.
  - 2. 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 6000 - Product Requirements, for additional provisions.
  - 2. Screwdrivers for Tamper-Resistant Screws: Two for each type of screw.
  - 3. Extra Keys for Locking Switches: Two of each type.
  - 4. Extra Surge Protection Receptacles: Two of each type.
  - 5. Extra Wall Plates: One of each style, size, and finish.
  - 6. Extra Flush Floor Service Fittings: Two of each type.
  - 7. Extra Poke-Through Core Hole Closure Plugs: Two for each core size.

#### **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of CEC.
- 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.

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- D. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## **1.07 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. Provide isolated ground receptacles for receptacles serving computers and electronic cash registers.
- I. Unless noted otherwise, do not use combination switch/receptacle devices.
- J. For flush floor service fittings, use tile rings for installations in tile floors.
- K. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

### **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 galvanized steel wall plate.
- E. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover.
- F. Wiring Devices Installed [ ]: White with white nylon wall plate.
- G. Isolated Ground Convenience Receptacles: Orange.
- H. Surge Protection Receptacles: Blue.
- I. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate.
- J. Above-Floor Service Fittings: Gray wiring devices with satin aluminum housing.
- K. Flush Floor Box Service Fittings: Gray wiring devices with aluminum cover and ring/flange.
- L. Flush Poke-Through Service Fittings: Gray wiring devices with aluminum cover and aluminum flange.
- M. Access Floor Boxes: Gray wiring devices with gray steel cover with insert to match floor covering.

### **2.03 WALL SWITCHES**

- A. Manufacturers:
  - 1. Hubbell Incorporated: [www.hubbell.com/#sle](http://www.hubbell.com/#sle).
  - 2. Leviton Manufacturing Company, Inc: [www.leviton.com/#sle](http://www.leviton.com/#sle).
  - 3. Pass & Seymour, a brand of Legrand North America, Inc: [www.legrand.us/#sle](http://www.legrand.us/#sle).

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- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable FS W-S-896; types as indicated on the drawings.
  - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- 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. 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.
- B. Control: Slide control type with separate on/off switch.

#### **2.05 RECEPTACLES**

- A. Manufacturers:
  - 1. Hubbell Incorporated: [www.hubbell.com/#sle](http://www.hubbell.com/#sle).
  - 2. Leviton Manufacturing Company, Inc; [\_\_\_\_]: [www.leviton.com/#sle](http://www.leviton.com/#sle).
  - 3. Lutron Electronics Company, Inc; Designer Style: [www.lutron.com/#sle](http://www.lutron.com/#sle).
  - 4. Pass & Seymour, a brand of Legrand North America, Inc; [\_\_\_\_]: [www.legrand.us/#sle](http://www.legrand.us/#sle).
  - 5. Substitutions: See Section 01 6000 - Product Requirements.
  - 6. 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. 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.
  - 3. Hospital Grade Receptacles: Listed as complying with UL 498 Supplement SD, with green dot hospital grade mark on device face.

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C. Convenience Receptacles:

1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
2. Automatically Controlled Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per CEC; single or duplex as indicated on the drawings.
3. 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.
4. 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.
5. 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.
6. 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.
7. Illuminated Convenience Receptacles: Hospital grade, 20A, 125V, NEMA 5-20R; illuminated face or indicator light to indicate power is being supplied to receptacle; 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.
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.

## 2.06 WALL PLATES

A. Manufacturers:

1. Hubbell Incorporated: [www.hubbell-wiring.com/#sle](http://www.hubbell-wiring.com/#sle).
2. Leviton Manufacturing Company, Inc: [www.leviton.com/#sle](http://www.leviton.com/#sle).
3. Lutron Electronics Company, Inc: [www.lutron.com/#sle](http://www.lutron.com/#sle).
4. Pass & Seymour, a brand of Legrand North America, Inc: [www.legrand.us/#sle](http://www.legrand.us/#sle).
5. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer 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.
4. Provide screwless wallplates with concealed mounting hardware where indicated.

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- C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.
- D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- E. Brass Wall Plates: Brushed satin finish, factory-coated to inhibit oxidation.
- F. Aluminum Wall Plates: Smooth satin finish, clear anodized, factory-coated to inhibit oxidation.
- G. Chrome Wall Plates: Smooth finish, chrome plated steel.
- H. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.
- I. Premarked Wall Plates: Factory labeled as indicated; hot stamped for nylon wall plates and engraved for metal wall plates.
- J. 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.
- K. 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.

## 2.07 FLOOR BOX SERVICE FITTINGS

- A. Manufacturers:
  - 1. Hubbell Incorporated: [www.hubbell.com/#sle](http://www.hubbell.com/#sle).
  - 2. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
  - 3. Wiremold, a brand of Legrand North America, Inc: [www.legrand.us/#sle](http://www.legrand.us/#sle).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Service fittings compatible with floor boxes provided under Section 26 0533.16 with components, adapters, and trims required for complete installation.
- C. Above-Floor Service Fittings:
  - 1. Single Service Pedestal Convenience Receptacles:
    - a. Configuration: One standard convenience duplex receptacle.
  - 2. Single Service Pedestal Communications Outlets:
    - a. Configuration: One 1 inch bushed opening.
    - b. Voice and Data Jacks: As specified in Section 27 1000.
  - 3. Single Service Pedestal Furniture Feed:
    - a. Configuration: One 3/4 inch knockout.
  - 4. Dual Service Pedestal Combination Outlets:
    - a. Configuration:
      - 1) Power: One standard convenience duplex receptacle.
      - 2) Communications: One 1 inch bushed opening.
      - 3) Voice and Data Jacks: As specified in Section 27 1000.
    - b. Provide barrier to separate line and low voltage compartments.
- D. 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 1000.
  - 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:

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- 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 1000.
  - 4) Voice and Data Jacks: Provided by others.
- 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](http://www.hubbell.com/#sle).

## 2.08 POKE-THROUGH ASSEMBLIES

- A. Manufacturers:
  - 1. Hubbell Incorporated: [www.hubbell.com/#sle](http://www.hubbell.com/#sle).
  - 2. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
  - 3. Wiremold, a brand of Legrand North America, Inc: [www.legrand.us/#sle](http://www.legrand.us/#sle).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Assembly comprising floor service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination; fire rating listed to match fire rating of floor and suitable for floor thickness where installed.
- C. Above-Floor Service Fittings:
  - 1. Single Service Pedestal Convenience Receptacles:
    - a. Configuration: One standard convenience duplex receptacle.
  - 2. Single Service Pedestal Communications Outlets:
    - a. Configuration: One 1 inch bushed opening.
    - b. Voice and Data Jacks: As specified in Section 27 1000.
  - 3. Single Service Pedestal Furniture Feed:
    - a. Configuration: One 3/4 inch knockout.
  - 4. Dual Service Pedestal Combination Outlets:
    - a. Configuration:
      - 1) Power: One standard convenience duplex receptacle.
      - 2) Communications: One 1 inch bushed opening.
      - 3) Voice and Data Jacks: As specified in Section 27 1000.
    - b. Provide barrier to separate line and low voltage compartments.
  - 5. Products:
    - a. Hubbell Incorporated: [www.hubbell.com/#sle](http://www.hubbell.com/#sle).
    - b. Substitutions: See Section 01 6000 - Product Requirements.
- D. Flush Floor Service Fittings:
  - 1. Single Service Flush Convenience Receptacles:
    - a. Configuration: One standard convenience duplex receptacle(s) with duplex flap opening(s).
  - 2. Single Service Flush Communications Outlets:
    - a. Configuration: [\_\_\_\_\_].
    - b. Voice and Data Jacks: As specified in Section 27 1000.

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3. Single Service Flush Furniture Feed:
  - a. Configuration: One 2 inch by 1-1/4 inch combination threaded opening(s).
4. Dual Service Flush Combination Outlets:
  - a. Cover: Hinged door(s).
  - b. Configuration:
    - 1) Power: One standard convenience duplex receptacle(s).
    - 2) Communications:
    - 3) Voice and Data Jacks: As specified in Section 27 1000.
5. Dual Service Flush Furniture Feed:
  - a. Configuration:
    - 1) Power: One 3/4 inch threaded opening(s).
    - 2) Communications: Two 1/2 inch threaded opening(s).
6. Accessories:
  - a. Closure Plugs: Size and fire rating as required to seal unused core hole and maintain fire rating of floor.

## 2.09 ACCESS FLOOR BOXES

- A. Manufacturers - Access Floor Boxes:
  1. Hubbell Incorporated: [www.hubbell-wiring.com/#sle](http://www.hubbell-wiring.com/#sle).
  2. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
  3. Wiremold, a brand of Legrand North America, Inc: [www.legrand.us/#sle](http://www.legrand.us/#sle).
  4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Manufacturers - Access Floor Boxes with Pre-wired Connectors for Manufactured Wiring Systems:
  1. AFC Cable Systems Inc: [www.afcweb.com/#sle](http://www.afcweb.com/#sle).
  2. RELOC Wiring Solutions, a brand of Acuity Brands, Inc: [www.relocwiring.com/#sle](http://www.relocwiring.com/#sle).
  3. Wiremold, a brand of Legrand North America, Inc; [\_\_\_\_]: [www.legrand.us/#sle](http://www.legrand.us/#sle).
  4. Substitutions: See Section 01 6000 - Product Requirements.
  5. Source Limitations: Provide access floor boxes with pre-wired connectors produced by the same manufacturer as the manufactured wiring system used for this project.
- C. Description: Metallic multi-service box suitable for mounting in access floor system specified in Section 09 6900.
- D. Access floor boxes with pre-wired connectors for manufactured wiring systems are permitted only where manufactured wiring systems are permitted as specified in Section 26 0519.
- E. Configuration:
  1. Power: Two standard convenience duplex receptacle(s).
  2. Communications:
  3. Voice and Data Jacks: Provided by others.

## 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 CEC.
- 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 floor boxes are adjusted properly.
- F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- G. Verify that core drilled holes for poke-through assemblies are in proper locations.

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- H. Verify that openings in access floor are in proper locations.
- I. 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 0533.16 as required for installation of wiring devices provided under this section.
  - 1. Mounting Heights: Unless otherwise indicated, as follows:
    - a. Wall Switches: 48 inches 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. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- J. 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.
- K. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.
- L. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- M. Install wall switches with OFF position down.
- N. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- O. Do not share neutral conductor on branch circuits utilizing wall dimmers.

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- P. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- Q. 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.
- R. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- S. Identify wiring devices in accordance with Section 26 0553.
- T. 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 4000 - Quality Requirements, for 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. Inspect each surge protection receptacle to verify surge protection is active.
- G. 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.

#### **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 26 2726**

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## SECTION 26 2813 FUSES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Fuses.
- B. Spare fuse cabinet.

#### 1.02 RELATED REQUIREMENTS

- A. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- B. Section 26 2413 - Switchboards: Fusible switches.
- C. Section 26 2416 - Panelboards: Fusible switches.
- D. Section 26 2419 - Motor-Control Centers: Fusible switches.
- E. Section 26 2513 - Low-Voltage Busways: Fusible switches.
- F. Section 26 2816.16 - Enclosed Switches: Fusible switches.
- G. Section 26 2913 - Enclosed Controllers: Fusible switches.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. NEMA FU 1 - Low Voltage Cartridge Fuses.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements.
- D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses.
- E. UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses.
- F. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses.
- G. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses.
- H. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
    - a. Fusible Switches for Switchboards: See Section 26 2413.
    - b. Fusible Switches for Panelboards: See Section 26 2416.
    - c. Fusible Switches for Motor Control Centers: See Section 26 2419.
    - d. Fusible Switches for Busway: See Section 26 2501.
    - e. Fusible Enclosed Switches: See Section 26 2816.16.
    - f. Fusible Switches for Enclosed Motor Controllers: See Section 26 2913.
  - 2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
  - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
  - 1. Spare Fuse Cabinet: Include dimensions.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.

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2. Extra Fuses: One set(s) of three for each type and size installed.
3. Fuse Pullers: One set(s) compatible with each type and size installed.
4. Spare Fuse Cabinet Keys: Two.

## 1.06 QUALITY ASSURANCE

- A. Conform to requirements of CEC.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation: [www.cooperindustries.com/#sle](http://www.cooperindustries.com/#sle).
- B. Littelfuse, Inc: [www.littelfuse.com/#sle](http://www.littelfuse.com/#sle).
- C. Mersen: [ep-us.mersen.com/#sle](http://ep-us.mersen.com/#sle).
- D. Substitutions: See Section 01 6000 - Product Requirements.

### 2.02 APPLICATIONS

- A. Service Entrance:
  1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
  2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.
- B. Feeders:
  1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
  2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.
- C. General Purpose Branch Circuits: Class RK1, time-delay.
- D. Individual Motor Branch Circuits: Class RK1, time-delay.
- E. In-Line Protection for Pole-Mounted Luminaires: Class CC, time-delay.
- F. Primary Protection for Control Transformers: Class CC, time-delay.

### 2.03 FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Class R Fuses: Comply with UL 248-12.
- H. Class L Fuses: Comply with UL 248-10.
- I. Class CC Fuses: Comply with UL 248-4.

### 2.04 SPARE FUSE CABINET

- A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.
- B. Finish: Manufacturer's standard, factory applied grey finish unless otherwise indicated.

## PART 3 EXECUTION

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### **3.01 EXAMINATION**

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that mounting surfaces are ready to receive spare fuse cabinet.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 INSTALLATION**

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.
- C. Install spare fuse cabinet where indicated.
- D. Identify spare fuse cabinet in accordance with Section 26 0553.

**END OF SECTION 26 2813**

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## SECTION 26 2816.13 ENCLOSED CIRCUIT BREAKERS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Enclosed circuit breakers.

#### 1.02 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
  - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
- I. UL 869A - Reference Standard for Service Equipment.
- J. UL 943 - Ground-Fault Circuit-Interrupters.
- K. UL 1053 - Ground-Fault Sensing and Relaying Equipment.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within dedicated equipment spaces and within working clearances for electrical equipment required by CEC.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.
  - 1. Include characteristic trip curves for each type and rating of circuit breaker upon request.

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- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  - 1. Include dimensioned plan and elevation views of enclosed circuit breakers and adjacent equipment with all required clearances indicated.
  - 2. Include wiring diagrams showing all factory and field connections.
  - 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
  - 4. Include documentation of listed series ratings upon request.
  - 5. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- 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, installation, and starting of product.
- G. Project Record Documents: Record actual installed locations of enclosed circuit breakers.
- H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

#### **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of CEC.
- 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. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed circuit breaker internal components, enclosure, and finish.

#### **1.08 FIELD CONDITIONS**

- A. Maintain ambient temperature between 23 degrees F and 104 degrees F during and after installation of enclosed circuit breakers.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. ABB/GE: [www.geindustrial.com/#sle](http://www.geindustrial.com/#sle).
- B. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
- C. Schneider Electric; Square D Products: [www.schneider-electric.us/#sle](http://www.schneider-electric.us/#sle).
- D. Siemens Industry, Inc: [www.usa.siemens.com/#sle](http://www.usa.siemens.com/#sle).
- E. Substitutions: See Section 01 6000 - Product Requirements.
- F. Source Limitations: Furnish enclosed circuit breakers and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

#### **2.02 ENCLOSED CIRCUIT BREAKERS**

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- A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Seismic Qualification: Provide enclosed circuit breakers and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.
- D. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
  - 1. Altitude: Less than 6,600 feet.
  - 2. Ambient Temperature: Between 23 degrees F and 104 degrees F.
- E. Short Circuit Current Rating:
  - 1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location indicated on the drawings.
  - 2. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 0573.
  - 3. Listed series ratings are .
  - 4. Label equipment utilizing series ratings as required by CEC.
- F. Enclosed Circuit Breakers Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
- H. Provide thermal magnetic circuit breakers unless otherwise indicated.
- I. Provide electronic trip circuit breakers where indicated.
- J. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- K. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.
- L. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
  - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1.
    - b. Outdoor Locations: Type 3R.
  - 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
  - 3. Provide surface-mounted enclosures unless otherwise indicated.
- M. Provide externally operable handle with means for locking in the OFF position.
- N. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
  - 1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
  - 2. Where accessory ground fault sensing and relaying equipment is used, equip companion circuit breakers with ground-fault shunt trips.
    - a. Use zero sequence ground fault detection method unless otherwise indicated.
    - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
    - c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.

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- O. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

## 2.03 MOLDED CASE CIRCUIT BREAKERS

- A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
- B. Interrupting Capacity:
- Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
    - 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
    - 14,000 rms symmetrical amperes at 480 VAC.
  - Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
  - Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
- C. Conductor Terminations:
- Provide compression lugs unless otherwise indicated.
  - Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
- D. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
- Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
  - Provide interchangeable trip units where indicated.
- E. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
- Provide the following field-adjustable trip response settings:
    - Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
    - Long time delay.
    - Short time pickup and delay.
    - Instantaneous pickup.
    - Ground fault pickup and delay where ground fault protection is indicated.
  - Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
  - Provide communication capability where indicated: Compatible with system indicated.
- F. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
- G. Provide the following circuit breaker types where indicated:
- Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
  - Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
  - Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
- H. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
- I. Provide listed high intensity discharge lighting rated circuit breakers with HID marking for all branch circuits serving HID lighting.

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- J. Provide the following features and accessories where indicated or where required to complete installation:
  - 1. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
  - 2. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
  - 3. Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
  - 4. Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed circuit breakers are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed circuit breakers.
- 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. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and CEC.
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Provide required seismic controls in accordance with Section 26 0548.
- F. Install enclosed circuit breakers plumb.
- G. Install flush-mounted enclosed circuit breakers so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- I. Provide grounding and bonding in accordance with Section 26 0526.
- J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- K. Set field-adjustable circuit breaker tripping function settings as indicated.
- L. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- M. Identify enclosed circuit breakers in accordance with Section 26 0553.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with manufacturer's instructions and NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers used for service entrance and for circuit breakers larger than [ ] amperes. Tests listed as optional are not required.
- D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
  - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.

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- E. Test GFCI circuit breakers to verify proper operation.
- F. Test shunt trips to verify proper operation.
- G. Correct deficiencies and replace damaged or defective enclosed circuit breakers.

#### **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 circuit breaker enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

**END OF SECTION 26 2816.13**

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## **SECTION 26 2816.16 ENCLOSED SWITCHES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Enclosed safety switches.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 2813 - Fuses.
- F. Section 26 2913 - Enclosed Controllers: Manual motor controllers.
- G. Section 26 3600 - Transfer Switches: Automatic and non-automatic switches listed for use as transfer switch equipment.

#### **1.03 REFERENCE STANDARDS**

- A. 2019 California Electrical Code (CEC).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).
- E. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- H. UL 98 - Enclosed and Dead-Front Switches.
- I. UL 869A - Reference Standard for Service Equipment.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by CE.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  - 1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.

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2. Include wiring diagrams showing all factory and field connections.
3. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- 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, installation, and starting of product.
- G. Project Record Documents: Record actual locations of enclosed switches.
- H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Section 01 6000 - Product Requirements, for additional provisions.
  2. See Section 26 2813 for requirements for spare fuses and spare fuse cabinets.

#### **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of CEC
- 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. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

#### **1.08 FIELD CONDITIONS**

- A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.
- B. General Electric Company: [www.geindustrial.com/#sle](http://www.geindustrial.com/#sle).

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. ABB/GE: [www.geindustrial.com/#sle](http://www.geindustrial.com/#sle).
- B. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
- C. Schneider Electric; Square D Products: [www.schneider-electric.us/#sle](http://www.schneider-electric.us/#sle).
- D. Siemens Industry, Inc: [www.usa.siemens.com/#sle](http://www.usa.siemens.com/#sle).
- E. Substitutions: See Section 01 6000 - Product Requirements.
- F. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

#### **2.02 ENCLOSED SAFETY SWITCHES**

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

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- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Seismic Qualification: Provide enclosed safety switches suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.
- D. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
  - 1. Altitude: Less than 6,600 feet.
  - 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- E. Horsepower Rating: Suitable for connected load.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Short Circuit Current Rating:
  - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
  - 2. Minimum Ratings:
    - a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
    - b. General Duty Single Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.
    - c. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
    - d. Double Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.
- H. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- I. Provide with switch blade contact position that is visible when the cover is open.
- J. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
  - 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- K. Conductor Terminations: Suitable for use with the conductors to be installed.
- L. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- M. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- N. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
  - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1.
    - b. Outdoor Locations: Type 3R.
  - 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
- O. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- P. Heavy Duty Switches:
  - 1. Comply with NEMA KS 1.
  - 2. Conductor Terminations:
    - a. Provide mechanical lugs unless otherwise indicated.
    - b. Provide compression lugs where indicated.
    - c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

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3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
  - a. Provide means for locking handle in the ON position where indicated.
- Q. General Duty Switches:
  1. Conductor Terminations:
    - a. Provide mechanical lugs.
    - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
  2. Provide externally operable handle with means for locking in the OFF position, capable of accepting two padlocks.
- R. Provide the following features and accessories where indicated or where required to complete installation:
  1. Hubs: As required for environment type; sized to accept conduits to be installed.
  2. Integral fuse pullers.
  3. Auxiliary Switch: SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close.
  4. Viewing Window: Positioned over switch blades for visual confirmation of contact position with door closed.
  5. Interlocked Receptacle: Integral pre-wired three phase, three wire, grounded type receptacle interlocked with switch mechanism to prevent insertion or removal of plug with switch in the ON position and to prevent switch from being placed in the ON position without matching plug inserted. Provide receptacle configuration as required to accept plug as indicated on the drawings.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

#### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and CEC.
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Provide fuses complying with Section 26 2813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- J. Identify enclosed switches in accordance with Section 26 0553.

#### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.

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- C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

#### **3.04 ADJUSTING**

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

#### **3.05 CLEANING**

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

**END OF SECTION 26 2816.16**

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## SECTION 26 2923 VARIABLE-FREQUENCY MOTOR CONTROLLERS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Variable frequency controllers.

#### 1.02 RELATED REQUIREMENTS

- A. Section 26 0529 - Hangers and Supports for Electrical Systems.
- B. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
  - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 2813 - Fuses.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems.
- C. NEMA ICS 7 - Industrial Control and Systems: Adjustable-Speed Drives.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
  - 1. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Test Reports: Indicate field test and inspection procedures and test results.
- F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Manufacturer's Field Reports: Indicate start-up inspection findings.
- H. Operation Data: NEMA ICS 7.1. Include instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions.
- I. Maintenance Data: NEMA ICS 7.1. Include routine preventive maintenance schedule.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Air Filters: Two of each type.

#### 1.05 QUALITY ASSURANCE

- A. Conform to requirements of CEC.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

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- 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.

## **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Variable Frequency Motor Controllers:
  - 1. ABB/GE: [www.geindustrial.com/#sle](http://www.geindustrial.com/#sle).
  - 2. Danfoss: [www.danfoss.com/#sle](http://www.danfoss.com/#sle).
  - 3. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
  - 4. Rockwell Automation, Inc.; Allen-Bradley Products: [ab.rockwellautomation.com/#sle](http://ab.rockwellautomation.com/#sle).
  - 5. Schneider Electric; Square D Products: [www.schneider-electric.us/#sle](http://www.schneider-electric.us/#sle).
  - 6. Siemens Industry, Inc: [www.usa.siemens.com/#sle](http://www.usa.siemens.com/#sle).
- B. Substitutions: See Section 01 6000 - Product Requirements.
- C. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.
- D. Source Limitations: Furnish variable frequency motor controllers and associated components produced by a single manufacturer and obtained from a single supplier.

### **2.02 DESCRIPTION**

- A. Variable Frequency Controllers: Enclosed controllers suitable for operating the indicated loads, in conformance with requirements of NEMA ICS 7. Select unspecified features and options in accordance with NEMA ICS 3.1.
  - 1. Employ microprocessor-based inverter logic isolated from power circuits.
  - 2. Employ pulse-width-modulated inverter system.
  - 3. Design for ability to operate controller with motor disconnected from output.
  - 4. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.
- B. Seismic Qualification: Provide variable frequency controllers and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.
- C. Enclosures: NEMA 250, Type 1, suitable for equipment application in places regularly open to the public.
- D. Finish: Manufacturer's standard enamel.

### **2.03 OPERATING REQUIREMENTS**

- A. Rated Input Voltage: 208 volts, three phase, 60 Hertz.
- B. Motor Nameplate Voltage: 200 volts, three phase, 60 Hertz.
- C. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
- D. Operating Ambient: 0 degrees C to 40 degrees C.
- E. Volts Per Hertz Adjustment: Plus or minus 10 percent.

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- F. Current Limit Adjustment: 60 to 110 percent of rated.
- G. Acceleration Rate Adjustment: 0.5 to 30 seconds.
- H. Deceleration Rate Adjustment: 1 to 30 seconds.
- I. Input Signal: 4 to 20 mA DC.

## **2.04 COMPONENTS**

- A. Display: Provide integral digital display to indicate output voltage, output frequency, and output current.
- B. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON.
- C. Furnish HAND-OFF-AUTOMATIC selector switch and manual speed control.
- D. Include undervoltage release.
- E. Control Power Source: Separate circuit.
- F. Door Interlocks: Furnish mechanical means to prevent opening of equipment with power connected, or to disconnect power if door is opened; include means for defeating interlock by qualified persons.
- G. Safety Interlocks: Furnish terminals for remote contact to inhibit starting under both manual and automatic mode.
- H. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.
- I. Manual Bypass: Furnish contactor, motor running overload protection, and short circuit protection for full voltage, non-reversing operation of the motor. Include isolation switch to allow maintenance of inverter during bypass operation.
- J. Emergency Stop: Use dynamic brakes for emergency stop function.
- K. Disconnecting Means: Include integral fused disconnect switch on the line side of each controller.
- L. Wiring Terminations: Match conductor materials and sizes indicated.

## **2.05 SOURCE QUALITY CONTROL**

- A. Shop inspect and perform standard productions tests for each controller.
- B. Make completed controller available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner at least 7 days before inspection is allowed.
- C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify Owner at least 7 days before inspections and tests are scheduled.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surface is suitable for controller installation.
- B. Do not install controller until building environment can be maintained within the service conditions required by the manufacturer.
- C. Verify that field measurements are as indicated on shop drawings.

### **3.02 INSTALLATION**

- A. Install in accordance with NEMA ICS 7.1 and manufacturer's instructions.
- B. Provide required support and attachment in accordance with Section 26 0529.
- C. Provide required seismic controls in accordance with Section 26 0548.
- D. Tighten accessible connections and mechanical fasteners after placing controller.
- E. Provide fuses in fusible switches; refer to Section 26 2813 for product requirements.

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- F. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- G. Identify variable frequency controllers in accordance with Section 26 0553.

### **3.03 FIELD QUALITY CONTROL**

- A. Provide the service of the manufacturer's field representative to prepare and start controllers.
- B. Perform field inspection and testing in accordance with Section 01 4000.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Perform inspections and tests listed in NETA ATS, Section 7.17. The insulation-resistance test on control wiring listed as optional is not required.

### **3.04 ADJUSTING**

- A. Make final adjustments to installed controller to assure proper operation of load system. Obtain performance requirements from installer of driven loads.

### **3.05 CLOSEOUT ACTIVITIES**

- A. Demonstrate operation of controllers in automatic and manual modes.

### **3.06 MAINTENANCE**

- A. See Section 01 7000 - Execution Requirements, for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.
- C. Provide service and maintenance of controllers for one year from Date of Substantial Completion.

**END OF SECTION 26 2923**

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## SECTION 26 3323 CENTRAL BATTERY EQUIPMENT

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Emergency power supply.
- B. Uninterruptible power supply (UPS) centralized emergency lighting inverters.
- C. Remote trouble alarm indicator.

#### 1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Perform Work in accordance with CEC.
- F. Section 26 5100 - Interior Lighting:
- G. Section 26 5600 - Exterior Lighting: Luminaires for interface with centralized emergency lighting inverters.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- D. NECA 416 - Recommended Practice for Installing Energy Storage Systems (ESS).
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

#### 1.04 EMERGENCY POWER SUPPLY

- A. NFPA 101 - Life Safety Code.

#### 1.05 RATINGS

- A. NFPA 111 - Standard on Stored Electrical Energy Emergency and Standby Power Systems.
- B. UL 924 - Emergency Lighting and Power Equipment.
- C. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.
- D. Output Voltage: 277 volts plus 5 percent, single phase.

#### 1.06 ADMINISTRATIVE REQUIREMENTS

- A. Inverter Output Frequency: 60 Hz plus 1 percent.
- B. Coordination:
- C. Efficiency: 90 percent minimum.
- D. Maximum Recharge Time: 12 hours following 1.5 hour discharge.
- E. Total Harmonic Distortion: Less than 10 percent at full resistive load.
- F. Battery: Nickel cadmium, sealed type battery.
- G. Accessories: Provisions for remote battery alarm.
- H. Instrumentation and Alarms: NFPA 111.

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- I. Charger: Dual rate, designed to maintain battery in full-charge condition during normal conditions.
- J. Coordination:
  - 1. Coordinate compatibility of centralized emergency lighting inverters to be installed with work provided under other sections or by others.
  - 2. 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 required by NFPA 70.
  - 3. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### **1.07 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.
- C. Shop Drawings: Indicate dimensions, input/output voltages, power ratings, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, and installed features and accessories.
- D. Specimen Warranty: Submit sample of manufacturer's warranty.
- 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. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
  - 1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.
- G. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- H. Maintenance contracts.
- I. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Enclosure Keys: Two of each different key.
  - 3. Battery Fuses: See Section 26 2813 for requirements for spare fuses and spare fuse cabinets.

#### **1.08 QUALITY ASSURANCE**

- A. Comply with the following:
  - 1. CEC (California Electrical Code).
  - 2. NFPA 101 (Life Safety Code).
  - 3. NFPA 111; meet requirements for Level 1 system.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

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- C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with centralized emergency lighting inverter systems of similar size, type, and complexity; manufacturer's authorized installer.

#### **1.09 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's instructions to avoid damage to inverter system components, enclosure, and finish.
- D. Do not exceed maximum ambient temperature requirements for batteries at any time, which reduces battery service life. Replace batteries exposed to temperatures in excess of manufacturer's requirements.

#### **1.10 FIELD CONDITIONS**

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

#### **1.11 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Inverter Assemblies: Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
- C. Batteries: Provide pro-rata warranty for the duration of rated design life.

### **PART 2 PRODUCTS**

#### **2.01 CENTRALIZED EMERGENCY LIGHTING INVERTERS - GENERAL REQUIREMENTS**

- A. Provide complete centralized emergency lighting inverter system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Inverter Assemblies: Manufactured units consisting of inverters, batteries, enclosures, and associated components specifically designed for emergency lighting applications; microprocessor-based utilizing pulse width modulation (PWM) with insulated gate bipolar transistors (IGBT's); listed and labeled as complying with UL 924.
  - 1. Battery Run Times of 90 Minutes: Listed as complying with UL 924 for "emergency lighting and power equipment".
  - 2. Battery Run Times Other than 90 Minutes: Listed as complying with UL 924 for "auxiliary lighting and power equipment".
- D. Provide inverters and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- E. Increase indicated power ratings as required to accommodate any applicable inverter load restrictions.
- F. Inverters Installed in Spaces Used for Environmental Air: Plenum rated; listed and labeled as complying with UL 2043, suitable for use in air-handling spaces.
- G. Battery System:
  - 1. Provide battery capacity as required for achieving battery run time indicated.
  - 2. Battery Charger: Microprocessor-controlled, temperature compensated; capable of returning supplied battery(s) from fully discharged to fully charged condition within time required by NFPA 111 and UL 924 unless otherwise indicated.
  - 3. Provide automatic low voltage battery disconnect to prevent battery "deep discharge" damage.

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- H. Enclosures:
  - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
  - 2. Hinged Doors: Lockable, with all locks keyed alike.
  - 3. Finish: Manufacturer's standard unless otherwise indicated.
- I. Surge Tolerance: Capable of withstanding characteristic surges according to IEEE C62.41.2, location category B.
- J. Automatic Sequence of Operations:
  - 1. Upon failure or degradation of primary/normal input power, transfer load to battery power.
  - 2. When primary/normal input power has been restored, retransfer load to primary/normal power and recharge battery.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of inverter assemblies are consistent with the indicated requirements.
- C. Verify that rough-ins for field connections are in the proper locations.
- D. Verify that mounting surfaces are ready to receive inverter assemblies.
- 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 inverter assemblies in accordance with applicable requirements of NECA 416.
- C. Install products in accordance with manufacturer's instructions.
- D. Arrange equipment to provide minimum clearances and required maintenance access.
- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Install inverter assemblies plumb and level.
- G. Unless otherwise indicated, mount floor-mounted inverter assemblies on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.

#### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Notify Owner and Architect at least two weeks prior to scheduled inspections and tests.
- C. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- D. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank.
- E. Prepare and start system in accordance with manufacturer's instructions.
- F. Perform acceptance test in accordance with NFPA 111.
- G. Inspect and test in accordance with NETA ATS, except Section 4.
- H. Perform inspections and tests listed in NETA ATS, Section 7.22.2.
- I. Batteries and Charger: Perform inspections and tests listed in NETA ATS, Section 7.18.
- J. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

#### **3.04 CLEANING**

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- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

### **3.05 CLOSEOUT ACTIVITIES**

- A. Demonstration: Demonstrate proper operation of emergency lighting inverter system to Owner, and correct deficiencies or make adjustments as directed.
- B. Training: Train Owner's personnel on operation, adjustment, and maintenance of emergency lighting inverter system.
  - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
  - 2. Location: At project site.

### **3.06 PROTECTION**

- A. Protect installed inverter assemblies from subsequent construction operations.

### **3.07 MAINTENANCE**

- A. Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of emergency lighting inverter system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.

**END OF SECTION 26 3323**

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## SECTION 26 4300 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 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 2300 - Low-Voltage Switchgear.
- C. Section 26 2413 - Switchboards.
- D. Section 26 2416 - Panelboards.
- E. Section 26 2419 - Motor-Control Centers.
- F. Section 26 2513 - Low-Voltage Busways.

#### 1.03 ABBREVIATIONS AND ACRONYMS

- A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.
- B. SPD: Surge Protective Device.

#### 1.04 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- E. UL 1283 - Standard for Electromagnetic Interference Filters.
- F. UL 1449 - Standard for Surge Protective Devices.

#### 1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

#### 1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for 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.
- 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. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.

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- F. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- G. Project Record Documents: Record actual connections and locations of surge protective devices.

#### **1.07 QUALITY ASSURANCE**

- A. Conform to requirements of CEC..

#### **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 7800 - Closeout Submittals, for 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. 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.
- B. Substitutions: See Section 01 6000 - Product Requirements.
- C. 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. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
  - 1. Indoor clean, dry locations: Type 1.
  - 2. Outdoor locations: Type 3R.
- C. Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:
  - 1. Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.
  - 2. Provide flush-mounted SPD where mounted in public areas or adjacent to flush-mounted equipment.
- D. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.

#### **2.03 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS**

- A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.

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- B. 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.
- C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.
- D. Surge Current Rating: Not less than 120 kA per mode/240 kA per phase.
- E. Repetitive Surge Current Capacity: Not less than 5,000 impulses.
- F. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

#### **2.04 SURGE PROTECTIVE DEVICES FOR DISTRIBUTION LOCATIONS**

- A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.
- B. List and label as complying with UL 1449, Type 1 or Type 2.
- C. Distribution locations include SPDs connected to distribution panelboards, motor control centers, and busway.
- D. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.
- E. Surge Current Rating: Not less than 80 kA per mode/160 kA per phase.
- F. Repetitive Surge Current Capacity: Not less than 3,500 impulses.
- G. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

#### **2.05 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS**

- A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.
- B. List and label as complying with UL 1449, Type 1 or Type 2.
- C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.
- D. Surge Current Rating: Not less than 60 kA per mode/120 kA per phase.
- E. Repetitive Surge Current Capacity: Not less than 2,000 impulses.
- F. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

### **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 that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.
- D. Verify system grounding and bonding is in accordance with Section 26 0526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.
- 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. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and CEC.

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- D. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.
- E. Provide conductors with minimum ampacity as indicated on the drawings, as required by NFPA 70, and not less than manufacturer's recommended minimum conductor size.
- F. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.
- G. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 0526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.
- H. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS Section 7.19.1.
- 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 26 4300**

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## SECTION 26 5100 INTERIOR LIGHTING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Drivers.
- E. Luminaire accessories.

#### 1.02 RELATED REQUIREMENTS

- A. Section 26 0529 - Hangers and Supports for Electrical Systems.
- B. Section 26 0533.16 - Boxes for Electrical Systems.
- C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 0923 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
- F. Section 26 2726 - Wiring Devices: Manual wall switches and wall dimmers.
- G. Section 26 5600 - Exterior Lighting.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. 47 CFR 15 - Radio Frequency Devices.
- C. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code).
- D. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.
- E. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information.
- F. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products.
- G. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources.
- H. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- I. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems.
- J. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems.
- K. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices.
- L. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility.
- M. NFPA 101 - Life Safety Code.
- N. UL 844 - Luminaires for Use in Hazardous (Classified) Locations.
- O. UL 924 - Emergency Lighting and Power Equipment.
- P. UL 1598 - Luminaires.
- Q. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

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- 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 the contract documents to obtain direction prior to proceeding with work.

## 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
  - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
  - 1. LED Luminaires:
    - a. Include estimated useful life, calculated based on IES LM-80 test data.
    - b. Include IES LM-79 test report upon request.
  - 2. 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. Samples:
  - 1. Provide one sample(s) of each luminaire where indicated.
- E. Field quality control 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: Instructions for each product including information on replacement parts.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.
  - 3. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.
- I. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

## 1.06 QUALITY ASSURANCE

- A. Conform to requirements of CEC.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

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- 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), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

#### **1.08 FIELD CONDITIONS**

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

#### **1.09 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide three year manufacturer warranty for LED luminaires, including drivers.
- C. 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.

#### **2.02 LUMINAIRES**

- A. Provide products that comply with requirements of CEC.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the source and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Hazardous (Classified) Location Luminaires: Listed and labeled as complying with UL 844 for the classification of the installed location.
- H. LED Luminaires:
  - 1. Components: UL 8750 recognized or listed as applicable.
  - 2. Tested in accordance with IES LM-79 and IES LM-80.
  - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.
- I. 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:

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- a. Color Rendering Index (CRI): Not less than 90.
- J. 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.
- K. 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. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. 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.
- C. Battery:
  - 1. Sealed maintenance-free lead calcium unless otherwise indicated.
  - 2. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- E. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- F. 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.
- G. Where indicated, provide units with integral time delay to maintain emergency illumination for 15 minutes after restoration of normal power source.
- 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: Internally illuminated exit signs with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
  - 1. Number of Faces: Single or double as indicated or as required for the installed location.
  - 2. Directional Arrows: As indicated or as required for the installed location.

## 2.05 LED DRIVERS

- A. LED Drivers - General Requirements:
  - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
  - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
  - 3. LED Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.
- 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.

## PART 3 EXECUTION

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### 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 CEC.
- 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 0533.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires 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 0529.
- F. Provide required seismic controls in accordance with Section 26 0548.
- G. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- H. 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. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
  7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- I. 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.
- J. 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.

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4. Install canopies tight to mounting surface.
5. Unless otherwise indicated, support pendants from swivel hangers.
- K. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- L. Install accessories furnished with each luminaire.
- M. Bond products and metal accessories to branch circuit equipment grounding conductor.
- N. 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.
- O. Exit Signs:
  1. Unless otherwise indicated, connect unit to unswitched power from circuit indicated. Bypass local switches, contactors, or other lighting controls.
  2. Install lock-on device on branch circuit breaker serving units.
- P. Identify luminaires connected to emergency power system in accordance with Section 26 0553.
- Q. Install lamps in each luminaire.

### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
- E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

### **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 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of luminaires to Architect, 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 26 5100**

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## SECTION 26 5600 EXTERIOR LIGHTING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Exterior luminaires.
- B. Poles and accessories.
- C. Luminaire accessories.

#### 1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0533.16 - Boxes for Electrical Systems.
- E. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
- F. Section 26 0923 - Lighting Control Devices: Automatic controls for lighting including outdoor motion sensors, time switches, and outdoor photo controls.
- G. Section 26 2726 - Wiring Devices: Receptacles for installation in poles.
- H. Section 26 2813 - Fuses.
- I. Section 26 5100 - Interior Lighting.

#### 1.03 REFERENCE STANDARDS

- A. 2019 California Electrical Code (CEC).
- B. 47 CFR 15 - Radio Frequency Devices.
- C. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.
- D. 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.
- E. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code).
- F. IEEE C2 - National Electrical Safety Code.
- G. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.
- H. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information.
- I. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products.
- J. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources.
- K. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- L. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems.
- M. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility.
- N. UL 1598 - Luminaires.
- O. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits.
- P. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

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#### 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 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
  - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
  - 3. Provide structural calculations for each pole proposed for substitution.
- 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. Lamps: Include rated life and initial and mean lumen output.
  - 4. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.
- D. Sustainable Design Documentation: Submit manufacturer's product data on lamp mercury content and rated lamp life, showing compliance with specified requirements.
- E. Samples:
  - 1. Provide one sample(s) of each specified luminaire where indicated.
- F. 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.
- G. Field Quality Control Reports.
  - 1. Include test report indicating measured illumination levels.
- H. 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.
- I. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.
  - 3. Extra Ballasts: Two percent of total quantity installed for each type, but not less than one of each type.
  - 4. Extra Fuses: Five percent of total quantity installed for each type, but not less than two of each type.

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5. Touch-Up Paint: 2 gallons, to match color of pole finish.

- K. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

## **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of CEC.
- 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 7800 - Closeout Submittals, for 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.

### **2.02 LUMINAIRES**

- A. Provide products that comply with requirements of CEC.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.
- H. LED Luminaires:
  - 1. Components: UL 8750 recognized or listed as applicable.
  - 2. Tested in accordance with IES LM-79 and IES LM-80.
  - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.
- I. 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.

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- c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.
- 2. White LED Tape:
  - a. Color Rendering Index (CRI): Not less than 90.
- J. Exposed Hardware: Stainless steel.

## 2.03 LED DRIVERS

- A. Ballasts/Drivers - General Requirements:
  - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
  - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
- 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. 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. Material: Steel, unless otherwise indicated.
  - 4. Shape: Square straight, unless otherwise indicated.
  - 5. Finish: Match luminaire finish, unless otherwise indicated.
  - 6. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.
  - 7. Unless otherwise indicated, provide with the following features/accessories:
    - a. Top cap.
    - b. Anchor bolts with leveling nuts or leveling shims.
    - c. Anchor base cover.
    - d. Provision for pole-mounted weatherproof GFI receptacle where indicated.
    - e. Hinged base.
- B. 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 CEC.
- 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.

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### 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 0533.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires in accordance with NECA/IESNA 501.
- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Provide required seismic controls in accordance with Section 26 0548.
- 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. 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 in 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. 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 3000.
      - 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.

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- b. Provide supplementary ground rod electrode as specified in Section 26 0526 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.
- 6. Install non-breakaway in-line fuse holders and fuses complying with Section 26 2813 in pole handhole or transformer base for each ungrounded conductor.
- 7. Install weather resistant GFI duplex receptacle with weatherproof cover as specified in Section 26 2726 in designated poles.
- 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 4000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.
- E. Measure illumination levels at night with calibrated meters to verify conformance with performance requirements. Record test results in written report to be included with submittals.

### **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 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of luminaires to Architect, 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.

### **3.09 ATTACHMENTS**

- A. Luminaire schedule.
- B. Luminaire cut sheets.

**END OF SECTION 26 5600**

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## SECTION 270500 COMMON WORK RESULTS FOR COMMUNICATIONS

### PART 1 -GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  1. Communications equipment coordination and installation.
  2. Sleeves for pathways and cables.
  3. Sleeve seals.
  4. Grout.
  5. Basket Tray
  6. Common communications installation requirements.

#### 1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

#### 1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications equipment:
  1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  3. To allow right of way for piping and conduit installed at required slope.
  4. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08

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#### Section "Access Doors and Frames."

- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping.".
- E. Coordinate all pathways with Districts standards.

1. This section consists of the equipment, materials and methods for all low voltage pathways and associated work included under Division 27 and 28 for the DJUSD.
2. Existing pathway shall be utilized whenever possible. Additional exposed pathways (conduits or exposed raceway) shall only be implemented in the design documents with District approval.
3. If cable pathway is exposed in occupied areas, provide solid bottom cable tray pathways, either center hung, or wall mounted.
4. District standards for site underground conduit is 4 ea. 2".
5. AT&T requirement for conduit is 2 ea. 4".
6. Comcast requirement for conduit is 1 ea. 2".
7. District preference for spare low voltage utility provider conduit is 1 ea. 2".
8. All wall junction boxes larger than 10" shall have a hinged lid.
9. All in-ground pull boxes with metal lids shall have the word "COMM" welded to the lid.
10. All conduit, boxes and supports shall be primed and painted to match existing conditions, adjacent roof surface or to best match building body color.
11. Cable bundles less than 24 ea. shall be routed utilizing J-Hooks.
  - a. Fiber Optics and Service Provider cable bundles shall be routed utilizing ORANGE colored J-Hooks.
  - b. Data copper cable bundles less than 24 ea. shall be routed utilizing YELLOW colored J-Hooks.
  - c. Data copper cable bundles in excess of 23 ea. shall be routed in a cable tray / wire basket above the ceiling (see below).
  - d. Clock, intercom and Audio-Visual (non-data) cable bundles shall be routed utilizing BLUE colored J-Hooks.
  - e. EMS and Lighting Control low voltage cables shall be routed utilizing GREEN colored J-Hooks.
12. Cable bundles in excess of 24 ea. shall be routed in a cable tray/wire basket above the ceiling. The cable tray/wire basket shall be routed down corridors if at all possible. A product such as Snake-Tray, sized and specified to allow proper fill ratio and mounting requirements is acceptable.
13. If cable pathway is exposed in occupied areas, provide solid bottom cable tray pathways, either center hung, or wall mounted.
14. Fire Alarm pathways shall be in red painted conduit. DUCTS

## 2.1 SLEEVES FOR PATHWAYS AND CABLES

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- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

## 2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
  - 3. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway
  - 4. Pressure Plates: Stainless steel. Include two for each sealing element.
  - 5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.4 Basket Tray and J Hook Non-Continuous Pathways

- A. Primary Pathways: The primary horizontal pathways shall be defined as those directly from the datacom room serving a section (a wing or side) of the building. The primary pathway components can be cable basket, or – if the total quantity of cables is less than 50 – cable hangers.
- B. Secondary Pathways: The secondary horizontal pathways shall be defined as those from the primary pathways serving an area of a section or to specific devices. The secondary pathway components can be cable hangers or, as an alternative, "Snake Tray" (by Cable Management Solutions).

## PART 3 - EXECUTION

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### 3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

### 3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

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- K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

### **3.3 SLEEVE-SEAL INSTALLATION**

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve.

### **3.4 FIRESTOPPING**

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

**END OF SECTION 270500**

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## SECTION 27 11 00 COMMUNICATIONS EQUIPMENT ROOMS

### PART 1 GENERAL

#### 1.1 SUMMARY

A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:

1. Equipment racks.
2. Server and network cabinets.
3. Vertical cable management.
4. Horizontal cable support.
5. Cable runways.

B. Related Work: Consult all other Sections, determine the extent and character of related Work and properly coordinate Work specified herein with that specified elsewhere to produce a complete installation.

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

#### **SECTION NO. SECTION TITLE**

260010	BASIC ELECTRICAL REQUIREMENTS
270500	BASIC COMMUNICATIONS REQUIREMENTS

#### 1.2 REFERENCES

A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:

1. American National Standards Institute, Inc. (ANSI):
2. Electronics Industries Alliance (EIA):
3. Factory Mutual System (FM):
4. Federal Communications Commission (FCC) Regulations:
5. Federal Specifications (FS):
6. Institute of Electrical and Electronic Engineers (IEEE):
7. National Electrical Manufacturer Association (NEMA):
8. National Fire Protection Association (NFPA):
9. Telecommunications Industry Association (TIA)
10. Underwriters Laboratories, Inc. (UL):

#### 1.3 DEFINITIONS

Communication Equipment Rooms	27 1100 - 1
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A. Above finish floor (AFF) - Standard mounting height (e.g., 18 inch AFF) for a device using the center line of the device as the measurement point.

B. Administration - The methodology defining the documentation requirements of a cabling system and its containment, the labeling of functional elements and the process by which moves, additions, and changes are recorded.

C. ANSI/TIA/EIA - Associations involved in developing telecommunications industry standards.

D. Attenuation - The decrease in magnitude of transmission signal strength between points, expressed in dB as the ratio of output to input signal level.

E. Attenuation-to-crosstalk ratio (ACR) - The ratio obtained by subtracting insertion loss (attenuation [dB]) from near-end crosstalk (dB). ACR is normally stated at a give frequency.

F. Auditory assistance device - An intentional radiator used to provide auditory assistance to a handicapped person or persons. Such a device may be used for auricular training in an educational institution, for auditory assistance at places of public gatherings, such as a church, theater, or auditorium, and for auditory assistance to handicapped individuals, only, in other locations.

G. Backboard - Backboard generally refers to the 3/4" A-C grade plywood sheeting, lining the walls of the telecommunications room. Plywood shall be void-free, with two coats of fire retardant paint matching the painted interior walls covering both sides.

H. Backbone - A facility (e.g., pathway, cable, or conductors) between any of the following spaces: telecommunications rooms, common telecommunications rooms, floor-serving terminals, entrance facilities, equipment rooms, and common equipment rooms.

I. Basic link test configuration - Horizontal cable of up to 90m (295 ft) plus up to 2m (6.5 ft) of test equipment cord from the main unit of the tester to the local connection, and up to 2m (6.5 ft) of test equipment cord from the remote connection to the remote unit of the tester. Maximum length is 94 m (308 ft).

J. Bonding Conductor (BC) - A conductor used specifically for the purpose of bonding.

K. Cable Labeling System:

1. The scheme employed when identifying cable or its associated hardware.
2. Scheme adapted for labeling cables to identify them based on ANSI/TIA/ EIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure.  
See administration.

L. Cable Runway - Hardware designed and manufactured for horizontal pathway distribution of cable and inside wiring inside the MC, IC, or TR rooms.

M. CAT - Category used when identifying the performance characteristics of twisted pair cabling.

N. Ceiling Distribution System - A distribution system that utilizes the space between a suspended or false ceiling and the structural surface above.

O. Closed-Circuit Television (CCTV) - A private television system, typically used for security purposes, in which the signal is transmitted to a limited number of receivers.

P. Communications plenum cable (CMP) - Type CMP communications plenum cable shall be listed as being suitable for use in ducts, plenums, and other spaces used for environmental air

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and shall also be listed as having adequate fire-resistant and low smoke-producing characteristics. (CEC)Cables must pass required test for fire and smoke characteristics of wires and cables, NFPA 262 or UL 910.

Q. Communications Riser Cable (CMR) - Type CMR communications riser cable shall be listed as being suitable for use in a vertical run in a shaft or from floor to floor and shall also be listed as having fire-resistant characteristics capable of preventing the carrying of fire from floor to floor. (CEC) Cables must pass requirements for flame propagation.

R. Electromagnetic Interference (EMI) - Radiated or conducted electromagnetic energy that has an undesirable effect on electronic equipment or signal transmissions.

S. Entrance Conduit - Conduit that connects the campus underground infrastructure with the building's Telecommunications Room.

T. Fire Retardant - Any substance added to delay the start or ignition of fire or slow the spread of the flame of any material. U. Firestopping - The process of installing [specialty] listed fire-rated materials into penetrations of fire-rated barriers to reestablish the fire-resistance rating of the barrier.

V. Firestopping Location. A penetration through a fire-rated wall with a sleeve.

W. Firestop System - A specific installation consisting of the material(s) (firestop penetration seals) that fill the opening in the wall or floor assembly, and around and between any items that penetrate the wall or floor (e.g., cables, cable trays, conduit, ducts, pipes), and any termination devices (e.g., electrical outlet boxes) along with their means of support.

X. Grounding Conductor - A conductor used to connect the grounding electrode to the buildings main grounding busbar.

Y. Grounding System - A system of hardware and wiring that provides an electrical path from a specified location to an earth ground point.

Z. Horizontal Cabling - The part of the cabling system that extends from the work area telecommunications outlet to the horizontal cross-connect in the telecommunications room.

AA. Hybrid Cable - An assembly of two or more cables, of the same or different types or categories, covered by one overall sheath.

BB. Infrastructure (Telecommunications) - A collection of those telecommunications components, excluding equipment, that together provide the basic support for the distribution of all information within a building or campus.

CC. Intermediate Cross-connect (IC) - the connection point between a backbone cable that extends from the main cross-connect and the backbone cable from the horizontal cross-connect.

DD. Loose Tube - A type of optical fiber cable construction where one or more fibers are laid loosely in a tube. Also called loose tube fiber.

EE. Main Cross-connect (MC) - The cross-connect normally located in the Telecommunications Equipment Room for cross-connection and interconnection of entrance cables, first-level backbone cables, and equipment cables.

FF. Metropolitan Area Network (MAN) - A data communications network that covers an area larger than a campus area and smaller than a wide area network. Typically interconnects two or more LANs and usually covers an entire metropolitan area. GG. MPOE - Minimum Point of Entry, Utility Partnerships/Alternate Carrier, usually located within the Telecommunications Room.

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HH. Multimode Fiber (MMF) - An optical fiber that carries many paths of light or an optical waveguide that allows many bound modes to propagate. II. Single-mode Fiber (SMF) - An optical fiber, usually step-index grade, which supports only one mode of light propagation. This does not necessarily imply single wavelength operation. The light source is normally a laser.

JJ. Strand (STR) - A single unit of optical fiber within a cable (e.g., a 12-strand fiber cable has 12 individual optical fibers within the cable sheath).

KK. Telecommunications Entrance Facility - Utility Partnerships/Alternate Carrier Minimum Point of Entry that is usually located within the Main Cross-connect Room (MC).

LL. Telecommunications Equipment Room (TER) - A centralized space that provides space and maintains a suitable operating environment for the termination of backbone and campus cabling and house centralized communications and/ or computer equipment (such as Core Switches and Servers). Note: An equipment room is considered distinct from a telecommunications closet because of the nature or complexity of the equipment housed by the equipment room.

MM. Telecommunications Main Grounding Busbar (TMGB) - A grounding busbar, located in the MC, connected to the main building ground electrode by a continuous 2/0 - #4 AWG wire (Wire size is dependent on the distance between the busbar and the building main).

NN. Telecommunications Room (TR) – A room dedicated to housing a group of telecommunications connectors (e.g., patch panel or punch-down block) that allows equipment and backbone cabling to be cross connected with patch cords or jumpers.

OO. Underwriters Laboratories (UL) - A United States-based independent testing laboratory that sets safety tests and standards.

PP. Uninterruptible Power Supply (UPS) - A device that is inserted between a primary power source (e.g., a commercial utility) and the primary power input of equipment to be protected (e.g., a computer system) to eliminate the effects of transient variances or temporary outages. Retain acronyms, abbreviations, and terms that remain after this Section has been edited.

#### 1.4 SYSTEM DESCRIPTION

A. The construction of cable runway, equipment racks and plywood backboards to support communications equipment, cabling, and termination hardware.

B. Grounding sub-system for bonding of equipment racks, cable runway, entrance cable, riser cable and conduits within the equipment room.

#### 1.5 SUBMITTALS

A. Items specified under this Section are Priority 1. Refer to Section 270010: Basic Communications Requirements for specific Priority 1 requirements.

B. Submit in accordance with the requirements of Section 270010: Basic Communications Requirements, the following items:

1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.

2. Shop Drawings to include:

- a. Enlarged equipment room plans of the racks, cabinets, overhead runway and conduit stubs into adjoining spaces.

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b. Wall and Rack Elevations with scaled components.

3. Furnish structural calculations for equipment anchorage as described in Section 270010: Basic Communications Requirements.

4. Submit Manufacturer's installation instructions.

5. Complete Bill of Material listing all components.

6. Final test results.

7. Warranty.

C. Dimensions and configurations of equipment shall conform to the space allocated on the Drawings. The Contractor shall submit a revised layout if equipment furnished varies in size from that indicated on Drawings for the Engineer's approval.

## **1.6 OPERATION AND MAINTENANCE MANUALS**

A. Supply operation and maintenance manuals in accordance with the requirements of Section 270010: Basic Communications Requirements, to include the following:

1. A detailed explanation of the operation of the system.

2. Instructions for routine maintenance.

3. Pictorial parts list and part numbers.

4. Pictorial and schematic Electrical Drawings of wiring systems, including operating and safety devices, control panels, instrumentation and annunciators.

5. Telephone numbers for the authorized parts and service distributors.

6. Include all service bulletins and torque Specifications for all terminations.

7. Final testing report.

## **1.7 QUALITY ASSURANCE**

A. All materials, equipment and parts comprising the units specified herein shall be new, unused and currently under production.

B. Only products and applications listed in this section may be used on the Project unless otherwise submitted.

C. Manufacturer qualifications: Manufacturer must have a minimum 5 continuous years of experience in design and manufacturing of the materials and equipment specified herein.

D. Installer's qualifications:

1. Installer must have a minimum 5 continuous years of experience in satisfactory completion for Projects similar in scope and cost. Provide backup information on 5 such Projects.

2. Installer shall possess a current, active and valid C7 or C10 California State Contractors License.

## **1.8 PRODUCT DELIVERY, STORAGE AND HANDLING**

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A. Delivery: Equipment components shall not be delivered to the Project site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Equipment damaged during shipment shall be replaced and returned to manufacturer at no cost to Owner. Components shall be properly packaged in factory-fabricated containers and mounted on shipping skids.

B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris and traffic. Provide heat where required to prevent condensation.

C. Handling: Handle in accordance with manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to Manufacturer.warranty

D. Units and components offered under this Section shall be covered by a 1 year parts and labor warranty for malfunctions resulting from defects in materials and workmanship. Warranty shall begin upon acceptance by the Owner.

### **1.9 EXTRA MATERIAL:**

A. Provide one spray can of matching finish paint for touching up damaged surfaces after installation.

B. Provide one (1) additional bag of 50 black rack screws.

## **PART 2 PRODUCTS**

### **2.0 MANUFACTURERS**

A. Products furnished by the following Manufacturers shall be acceptable if in compliance with all features specified herein and indicated on the Drawings.

1. Equipment racks and cable runways:

a. Chatsworth Product Inc. "CPI."

2. Bonding strap:

a. Chatsworth Product Inc. "CPI."

3. Bonding connectors and lugs:

a. Chatsworth Product Inc. "CPI."

### **2.1 MPOE AND MDF DISTRICT DESIGN STANDARDS**

A. Provide dedicated 4'x8' min. fire rated  $\frac{3}{4}$ " plywood on all walls requiring utility MPOE equipment anchoring with fire rated label clearly shown for inspection.

B. Utilize rack mount MPOE hardware where applicable and available from utility provider(s).

C. Provide 1 ea. 120vac/20amp dedicated electrical circuit for MPOE connectivity.

D. Install Cat5 cabling for termination to 66-block bridge at remote MPOE to MDF locations. The cable terminations on the MDF side shall be terminated on RJ-45 jacks, gray color, single pair per port.

E. Planning for incoming service tie-in from utility carrier(s) shall consider:

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1. Elevators/handicap lift locations will require a connection for emergency use
2. Fire and Intrusion offsite alarm monitoring will require a POTS/1MB type connection in addition to the IP alarm connection(s).
3. VoIP failover communication circuit shall be considered.
4. Carrier service requirement shall be coordinated with District ITS Department.

F. There shall be a minimum of one MDF and/or IDF per wing and per floor. Depending on distances of anticipated cable runs and the quantity of cables to be pulled, there might be a requirement for additional IDFs per floor.

G. MDF design standards:

H. The MDF and each IDF shall be equipped with an HVAC unit, properly sized for proposed active equipment. HVAC unit shall not be mounted directly above any electronic equipment to avoid any potential moisture damage.

I. Minimum room size for a new MDF shall be as outlined below, which differs depending on if it is intended for an Elementary School (60 SQFT), Middle School (86 SQFT) or High School (110 SQFT). The room shall be dedicated for Technology and Fire-Life-Safety systems. All walls on the MDF shall be covered with  $\frac{3}{4}$ " fire-rated plywood. If the plywood is painted with fire-retardant paint, the plywood rating stamp must be protected so it is visible after painting.

J. All new dedicated MDF rooms shall have 4-post rack(s) installed. Each side that is exposed to the room shall have a solid side panel installed.

K. Multiple floor mounted racks shall be organized in rows with vertical wire management (6" min.) in between each rack and on each end. Adequate workspace shall be 36" in front and behind each rack.

L. The MDF room shall have:

1. UL listed ladder rack/cable management on top of each rack connected to all 4 walls.
2. Ladder rack height shall be min. 6" above highest equipment enclosure.
  - a. UL listed cable management on the wall if conduits enter from the ground or excess of 12" above the horizontal ladder rack for the room. Preference is an 18" ladder rack mounted vertically on the wall directly above the conduits.
  - b. Light fixtures. The fixtures shall be mounted in front of and behind the rack. Lights shall not be mounted directly above the rack.
3. A minimum of one convenience receptable on each of the walls in the room.
  - a. Provide ground bus bar, bonding straps, and connection to grounding source.
4. If existing MDF is in an area where construction will generate dust, the entire rack or cabinet shall be protected from dust. Extra care shall be taken to provide ventilation of the rack/cabinet if it is covered to allow air to circulate through the rack/cabinet for the equipment not to overheat.
5. MDF rack designed to be equipped with:
  - a. Threaded rack rails.

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b. One dedicated 220V outlet and two duplex 110V outlets, on a single dedicated circuit, mounted at the top of each rack.

c. Horizontal rack mount power distribution units (PDU), 2-per rack.

d. Top of each rack shall have 2 ea. rack units unoccupied for future flexibility and growth.

6. Design of the rack layout shall allow a minimum of 5 ea. Rack units at the bottom of the rack to allow the district equipment vendor to install 1 ea. appropriately sized uninterruptable power supply (UPS) at each rack to provide 2-hour backup from loss of power.

a. The UPS shall include a network management card with environmental sensor kit for each UPS.

b. Horizontal wire management shall be installed in-between each switch and patch panel.

7. Contractor is to coordinate with District ITS and District Equipment Vendor to furnish all required data switches. Contractor is not responsible to furnish or install the active data equipment. Designer to coordinate with District ITS for specific port density requirements.

k. PoE switch port load needs to be coordinated with District ITS for all the above listed systems.

7. IDF design standards:

a. Minimum room size for a new IDF in a wing shall be minimum of 60 SQFT as listed above.

b. Preferred IDF size is 6' x 10':

c. If the IDF is in a dedicated room, the room shall have an independent cooling unit, sized to keep the room cool based on anticipated heat load from anticipated equipment.

d. If space requires a smaller room than the 60 SQFT, the district will allow the following solution

e. All walls on the IDF shall be covered with ¾" fire-rated plywood. If the plywood is painted with fire-retardant paint, the plywood rating stamp must be protected so it is visible after painting.

f. If the location is in an open room environment (i.e. classroom), design drawings shall provide a floor mount, wall anchor mounted Middle Atlantic SR-24-32 (62" height) with threaded rack rails for equipment mounting.

g. If the cabinet is located in an occupied area (i.e. classroom, meeting room, etc.), engineer/designer shall coordinate to make sure design drawings include a metal shroud from the top of the rear section of the cabinet (the section secured to the wall) up to the ceiling in order for conduit or cables to not be exposed in the room itself. The shroud shall be of 16gauge galvanized metal, painted to match cabinet (typically black).

h. Cabinets shall be lockable, same key to open all cabinets. Coordinate with district when added rack to existing site location for key series matching.

i. Each of the IDF room shall have:

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- i. UL listed ladder rack/cable management on top of each rack connected to all 4 walls.
- ii. Ladder rack height shall be min. 6" above highest equipment enclosure.
- iii. UL listed cable management on the wall if conduits enter from the ground or excess of 12" above the horizontal ladder rack for the room. Preference is an 18" ladder rack mounted vertically on the wall directly above the conduits.
- iv. Light fixtures. The fixtures shall be mounted in front of and behind the rack. Lights shall not be mounted directly above the rack.
- v. A minimum of one convenience receptable on each of the walls in the room.
- vi. Provide ground bus bar and bonding straps.
- j. If existing IDF is in an area where construction will generate dust, the entire rack or cabinet shall be protected from dust. Extra care shall be taken to provide ventilation of the rack/cabinet if it is covered to allow air to circulate through the rack/cabinet for the equipment not to overheat.
- k. IDF rack shall be equipped with:
  - i. Threaded rack rails.
  - ii. Top of each rack shall have 2 ea. rack units unoccupied for future flexibility and growth.
  - iii. One dedicated 220V outlet and two duplex 110V outlets, single dedicated circuit, mounted at the top of each rack.
  - iv. Horizontal rack mount power distribution units (PDU), 1-per rack.
  - v. Design of the rack layout shall allow a minimum of 5 ea. Rack units at the bottom of the rack to allow the district equipment vendor to install 1 ea. uninterruptable power supply (UPS) at each rack appropriately sized to provide 2 hours battery backup after loss of power.
  - vi. The UPS shall include a network management card with environmental sensor kit.
  - vii. Horizontal wire management shall be installed in-between each switch and patch panel.
- l. Contractor is to coordinate with District ITS and District Equipment Vendor to furnish all required data switches. The building contractor is not responsible to furnish or install the active data equipment. Designer to coordinate with District ITS for specific port density requirements. PoE switch port load needs to be coordinated with District ITS for all the above listed systems.

## **2.2 EQUIPMENT RACKS, 2 CHANNEL TYPE:**

A. Application: Suitable for the support of termination apparatus, cable and cord management apparatus, network equipment, and other similar equipment within a telecommunication room.

B. Material: High-strength, lightweight, #6061-T6 extruded aluminum construction or , 11 Ga. ASTM A570 steel uprights and ASTM A36 steel angles.

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C. Channel:

1. Size: 3" deep with flanges on each side (double sided).
2. Flange: 1.265" wide by 0.25" thick with mounting holes.
3. Mounting holes: Threaded mounting holes at #12-24 rolled and spaced 5/8"–5/8"–1/2", compatible with ANSI/EIA-310-D.
4. RMU markings: The RMU markings shall be permanently stamped on the outside of both flanges on both channels.

D. Assembled rack: Rack shall be complete with two mounting channels, two base angles (3.5" high by 6" deep by 0.375" thick), two top angles (1.5" high by 1.5" deep by 0.375" thick). Rack shall be 7'-0" high (overall) by 19" mounting width (20.25" width overall and shall contain 45 EIA mounting spaces (1.75" on center).

E. Load rating: 1000 lbs, when evenly distributed for the height of rack.

F. Finish: Powder coat, black.

G. Accessories: Include required accessories, such as floor installation kits, mounting hardware, etc. for a complete installation.

H. Rack Model & Part Number:

1. Standard Rack 3"D
2. Part #46353-703

**2.3 EQUIPMENT RACKS, 4 CHANNEL TYPE:**

A. Application: Suitable for the support of termination apparatus, cable and cord management apparatus, network equipment, and other similar equipment within a telecommunication room.

B. Material: High-strength, lightweight, #6061-T6 extruded aluminum construction, 11 Ga. ASTM A570 steel uprights and ASTM A36 steel angles.

C. Channel:

1. Size: 3" deep with flanges on each side (double sided).
2. Flange: 1.265" wide by 0.25" thick with mounting holes.
3. Mounting holes: Threaded mounting holes at #12-24 rolled and spaced 5/8"–5/8"–1/2", compatible with ANSI/EIA-310-D.
4. RMU markings: The RMU markings shall be permanently stamped on the outside of both flanges on both channels.

D. Assembled rack: Rack shall be complete with four rack channels, two base angles (3.5" high by 6" deep by 0.375" thick), two top angles (1.5" high by 1.5" deep by 0.375" thick), one extension pan set, Rack shall be 7'-0" high (overall) by 19" mounting width (20.25" width overall, 29" deep and shall contain 45 EIA mounting spaces (1.75" on center).

E. Load rating: 2000 lbs, when evenly distributed for the height of rack.

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F. Finish: Powder coat, black.

G. Accessories: Include required accessories, such as floor installation kits, mounting hardware, etc. for a complete installation.

H. Rack Model & Part Number:

1. 4 Post Standard Rack

2. Part #50120-703

## 2.4 VERTICAL MANAGEMENT SECTION:

A. Application: Suitable for cable routing (back) and cord slack storage (front) vertically within a rack bay, from bottom of rack to the top.

B. Configuration: The vertical management sections shall be double-sided having covered cable guides on the front and flip-retainers on the rear.

C. Size and capacity between racks: 7'-0" high by 10" wide by 20.2" deep.

D. Mounting: The vertical management sections shall have matching bolt holes for attachment to equipment rack.

E. Finish: Black, guide and cover.

F. Model and Part Number:

1. Model Evolution g3 Combination Vertical Cable Manager

a. 10"W Part #35573-703

## 2.5 CABLE RUNWAY SYSTEM

A. Runway type cable ladders shall consist of two longitudinal members (stringers) with transverse members (rungs) welded to the stringers. Rungs shall be spaced 9" inches on center. Rung spacing in radius fittings shall be 9 inches and measured at the center of the cable ladder's width. Rungs shall have a minimum cable bearing surface of 1" with radius edges. No portion of the rungs shall protrude below the bottom plane of the side rails.

B. Straight cable runway sections shall have side rails fabricated as tubular steel channels. All straight sections shall be supplied in standard 10' foot lengths, except where shorter lengths are permitted to facilitate cable runway assembly lengths as shown on drawings.

C. Cable runway widths shall be 12", 18" or 24" inches as indicated on drawings.

D. Splice plates shall be the bolted type made as indicated below for each cable ladder type. The resistance of fixed splice connections between an adjacent section of cable runway shall not exceed .00033 ohm. Splice plate construction shall be such that a splice may be located anywhere within the support span without diminishing the cable ladder rated loading capacity.

E. All splice materials shall be made of ASTM A570 structural steel using carriage bolts and serrated flange locknuts. Hardware shall be powder coated black.

F. Cable runway Supports: Shall be placed so that the support spans do not exceed a maximum span of 5' feet. Supports shall be constructed from formed shape channel members 1 5/8" x 1 5/8" with necessary hardware such as trapeze support kits, ceiling support kits, triangular support brackets, wall angle support kits, cable drop outs, etc... as provided by the same manufacturer.

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G. Trapeze hangers shall be supported by 5/8" (minimum) diameter all thread rods. All thread rods shall be equipped with threaded rod covers to protect cable from damage during installation.

H. Accessories - special accessories shall be furnished as required to protect, support, and install a cable ladder system. Accessories shall consist of but are not limited to; section splice plates, expansion plates, blind-end plates, specially-designed ladder drop-outs, barriers, etc.

I. All cable runway, splice hardware, and support hardware shall be powder coated black.

## **2.6 LOADING CAPACITIES**

A. Cable ladders shall meet NEMA class designations: 8A.

## **2.7 LABEL PLATES FOR EQUIPMENT RACKS:**

A. Label plates shall be suitable to affix onto top angle of equipment rack.

B. Label plate shall be "engrave-able" stock melamine plastic laminate substrate.

C. Size: 1/2" high by 6" long by 1/16" thick.

D. Lettering shall be white, engraved, 1/8" high.

E. Model and Part #:

1. Model UL Classified Cable Runway

2. Part #11275-7xx (xx=Size

## **2.8 PLYWOOD BACKBOARDS**

A. Application: Plywood backboards shall be placed on all walls of the telecommunications equipment room to 100" AFF. Bottom of plywood shall be 4" AFF The plywood will support wall mounted equipment, termination blocks, ladder support, etc...

1. Plywood backboards shall be A-C grade, 3/4"x8'Hx4'W, void free and sanded one side.

2. Paint plywood with 2 coats of fire retardant paint on both sides and edges. Color to match painted interior.

## **2.9 CONDUIT SLEEVES**

A. Application: Sleeves between the telecom room and adjacent ceiling for conveying cable to cable tray or J-hooks.

B. Conduit shall be 4" EMT with bushings

C. Each conduit shall be equipped with a 4" conduit waterfall.

1. Panduit #CWF400

## **2.10 SOUND PROOFING INSULATION**

A. Application: Sound Proofing conduit sleeves between spaces above ceiling.

1. Acoustical Surfaces, Inc.

a. UltraTouch Cotton Fiber Insulation

b. or equal

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## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

A. Contractor shall thoroughly examine Project site conditions for acceptance of equipment installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

### **3.2 APPLICATION**

A. Provide support equipment in telecommunications equipment rooms to support cable infrastructure, network equipment, horizontal cabling, patch cords and entrance cable.

### **3.3 EQUIPMENT RACKS AND WALL-MOUNTED ENCLOSURES**

#### **A. Installation**

1. Equipment racks shall be mounted to the floor using drop-in type anchors.
2. Mount equipment racks per dimensions stated on the construction drawings to allow proper clearances and preserve future growth.
3. Equipment racks shall be mounted square and level.
4. Equipment racks shall be supported laterally by the cable runway which is mounted to the equipment room wall.
5. Each equipment rack shall be grounded to the Telecommunication Grounding Bus bar with a dedicated #6 AWG wire. Daisy-chaining racks are not allowed.
6. Wall-mounted enclosures shall be mounted to the wall studs at six places minimum. Pre-drill plywood backboards prior to mounting to assure proper stud anchoring.
7. Wall-mounted enclosures shall be mounted level and mounting rails installed with 6" of clearance to the front of enclosure door.
8. Wall-mounted enclosures shall be mounted so they can swing open with proper clearances. Cables shall maintain proper slack to allow opening of enclosures.
9. Wall-mounted enclosures shall be grounded to an electrical panel ground bus with a #6 AWG wire.

### **3.4 CABLE MANAGEMENT**

#### **A. Vertical Managers**

1. All equipment racks shall contain vertical managers between racks and on each end of racks.
2. Attach managers securely to equipment racks.
3. Provide cable protection with radius drops or plastic inserts into managers that allow cables to be free of kinks or cuts.

#### **B. Horizontal Managers**

1. All equipment racks shall contain horizontal managers above, between and below all patch panels, equipment and district installed switches.

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2. Secure managers with at least four rack screws.
3. Utilize managers on the backs of all premises cable equipment racks to properly dress cable terminations.

### 3.5 CABLE RUNWAY

#### A. Installation

1. All cable ladder will be installed in spaces indicated on drawings. Cable ladder is not acceptable in the space above the ceiling for distribution of horizontal cable runs.
2. Install cable ladders as indicated; in accordance with equipment manufacturer's instructions, and with recognized industry practices, to ensure that cable ladder equipment comply with requirements of CEC, and applicable portions of NFPA 70b and NECA's "Standards of Installation" pertaining to general electrical installation practices.
3. All cable ladder shall be supported from the ceiling structure and at top of cabinets. Horizontal Cable ladder shall not be supported from the wall.
4. Provide dimensional structural restraints around the cable ladder for transverse and longitudinal bracing.
5. Coordinate cable ladder with other electrical work as necessary to properly interface installation of cable ladder work with other work.
6. Provide sufficient space encompassing cable ladders to permit access for installing and maintaining cables.
7. Ground all cable ladder to the communications room bus bars. Use ground straps between each section of runway installed or where splice plates are used to join sections. Scrape paint away from cable runway at points of connection to each section of runway by the ground strap.

#### B. Testing

1. Demonstrate compliance with specified maximum grounding resistance. Refer to NFPA70B, Chapter 18, for testing and test methods.

### 3.6 FIBER OPTIC AND COPPER PATCH PANELS

- A. Mount all patch panels securely with at least four rack screws.
- B. All patch panels shall be labeled accordingly. The panel located at the top of the equipment rack shall be 01, and then 02, 03, etc.
- C. All patch panels shall have the cables that reside in the patch panel clearly identified. This shall be accomplished with self adhesive, machine printed labels.
- D. All fiber patch panels shall be fully populated with fiber coupling mounting plates or blank mounting plates.

### 3.7 PLYWOOD BACKBOARDS

- A. Mount bottom of plywood backboards 3" AFF and to 100" above Finished Floor.
- B. Secure plywood to wall studs 12"OC vertically, 16" OC horizontally and within 2" from top & bottom edge of plywood.

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C. Use #12 galvanized flat head screws with 2.5" min. embedment. Use wood screws into wood studs, Self Drilling Screws into metal studs, and concrete anchors into concrete.

### 3.8 CONDUIT SLEEVES

A. Mount above ceiling through non-rated wall

B. Secure to wall material on each side of structure with conduit mounting brackets. conduit shall be have 6" min. on each side of wall. Place bushings on both ends of conduit prior to installing cable.

C. Provide 3" of sound insulation into sleeves at each end after installation of cable.

### 3.9 FIELD QUALITY CONTROL

A. At least three weeks prior to any testing, notify the Engineer so that arrangement can be made for witnessing test, if deemed necessary. All pretesting shall have been tested satisfactorily prior to the Engineer's witnessed test.

B. Test cable ladder, & racks to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. Refer to NFPA70B, Chapter 18, for testing and test methods.

#### 1. Visual and mechanical inspection:

a. Visually inspect all rack support hardware, cable runway, runway support hardware, splice connectors and structural supports for loose bolts, nuts and other connection hardware that could cause the mechanical failure of cable support systems.

b. Inspect ground connections to conduits, cable runway, equipment racks, BEP's, backbone cables and bus bars for mechanical integrity of the bond between ground cable and grounded equipment.

c. Inspect the ground bus between electrical ground and each bus bar in system.

#### 2. Test values:

C. In the event that the system fails to function properly during the testing as a result of inadequate pretesting or preparation, the Contractor shall bear all costs incurred by the necessity for retesting including test equipment, transportation, subsistence and the Engineer's hourly rate.

D. Contractor shall replace at no costs to the Owner, all equipment and devices which are found defective or do not operate within factory specified tolerances.

E. Contractor shall submit final report for review prior to Project closeout and final acceptance by the Owner. Test report shall indicate test dates, devices tested, results, observation, deficiencies and remedies. Test report shall be included in the operation and maintenance manuals.

### 3.10 CLEANING

A. Upon completion of Project prior to final acceptance the Contractor shall thoroughly clean all equipment per Manufacturers approved methods and materials. Remove paint splatters and other spots, dirt and debris.

B. Touch-up paint any marks, blemishes or other finish damage suffered during installation.

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**END OF SECTION 27 11 00**

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## SECTION 27 13 00 COMMUNICATION BACKBONE CABLING

### **PART 1 – GENERAL**

#### **1.01 SUMMARY**

- A. This section specifies equipment, accessories, materials, installation, configuration and testing requirements for a complete and operable Communications Backbone Cabling system. The system shall provide highly reliable and high-performance data communication from main distribution frame (MDF) to each intermediate distribution frame (IDF) or end points requiring fiber optics cabling.

#### **1.02 SCOPE**

- A. The work will include but not be limited to the following objectives:
1. For new construction – provide, coordinate, and install all required components and accessories as outlined in the design documents for a complete and operable system.
  2. For existing construction – provide, coordinate, and install all components and accessories as outlined in the design documents to modify the existing system while maintaining compliance and to seamlessly integrate the new components into the existing campus' system.
  3. Labor and Materials: The Contractor shall provide and pay for all labor, materials, equipment, tools, utilities, construction equipment and machinery, transportation and other facilities and services necessary for the proper execution, operation and completion of the Work.
  4. The Contractor shall furnish and install all new conduit/raceway and wire as indicated on the project drawings and/or as required to provide a turn-key system to the District.
  5. The Contractor shall terminate all strands of fiber at each fiber enclosure. All cables shall be installed with a minimum 10' service loops at MDF/IDF locations. Fiber will be terminated using SC type connectors.
  6. Service loops shall be secured to backboard or rear of cabinet using a pre-manufactured fiber optic wheel with Velcro straps. If installed at rear of cabinet, the wheel shall be placed at a height that will not interfere with equipment to be installed in the cabinet.
  7. If applicable, existing systems shall remain operable until new systems are accepted and approved by the District or its representative.
  8. The contractor shall complete all required project closeout documentation in a timely fashion.
  9. Testing of fiber and connections to insure a complete and operable end-to-end data connection using ANSI/TIA 568-C and ANSI/TIA/526-7 testing guidelines for multi-mode fiber.
  10. Fiber installs to carry Corning warranty (see Division 27 05 00 for requirements)
- B. VOICE COPPER BACKBONE- This work relates only to sites where the district has not activated a Voice over IP platform or if special circumstances requires an analog copper connection. The work will include but not be limited to the following objectives:

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1. MPOE
  - a. backbone feeder cables shall be at a minimum Category 5, size and number of pairs as indicated in drawings and Scope of Work documents, but never less than 8 pairs.
  - b. All pairs are to be terminated as follows:
    - i. At the MPOE end, on 66-blocks.
    - ii. At the MDF end, individual jack per pair, single pair per RJ45 port, housed in 4-port or larger surface mount box.
2. Buildings requiring an analog fax connection
  - a. backbone feeder cables shall be at a minimum Category 5, size and number of pairs as indicated in drawings and Scope of Work documents, but never less than 4 pairs.
  - b. All pairs are to be terminated as follows:
    - i. At the IDF end, individual jack per pair, single pair per RJ45 port, housed in 4-port or larger surface mount box.
    - ii. At the MDF end, individual jack per pair, single pair per RJ45 port, housed in 4-port or larger surface mount box.
3. Buildings requiring an analog tie-in to the intercom head end unit
  - a. backbone feeder cables shall be at a minimum Category 5 SHIELDED cable, size and number of pairs as indicated in drawings and Scope of Work documents, but never less than 4 pairs.
  - b. All pairs are to be terminated as follows:
    - i. At the IDF end, individual jack per pair, single pair per RJ45 port, housed in 4-port or larger surface mount box.
    - ii. At the MDF end, individual jack per pair, single pair per RJ45 port, housed in 4-port or larger surface mount box.

## **1.02 RELATED REQUIREMENTS**

- A. Division 01 00 00 – General Requirements
- B. Division 27 05 00 – Common Work Results for Communication Systems
- C. Division 27 11 00 – Equipment Rooms and Enclosures
- D. Division 27 15 00 – Communication Horizontal Cabling

## **1.03 INDUSTRY GUIDELINES AND STANDARDS**

- A. ANSI/TIA-568-1.D: Commercial Building Telecommunications Cabling Standard. (2018)
- B. ANSI/TIA -568-C.2: Balanced Twisted-Pair Telecommunications Cabling and Components Standard. (2016)
- C. ANSI/TIA -568-3.D: Optical Fiber Cabling Components Standard. (2016)

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- D. ANSI/TIA/EIA-569-D: Telecommunications Pathways and Spaces. (2018)
- E. ANSI/TIA -568-D: Measurement of Optical Power Loss of Installed Fiber Optic Cable Plant(2017)
- F. ANSI/TIA -598-D: Optical Fiber Cable Color Coding. (2018)
- G. ANSI/TIA -606-C: Administration Standard for Telecommunications Infrastructure. (2017)
- H. ANSI/TIA -607-C: Generic Telecommunications Bonding and Grounding (Earthing) Requirements for Customer Premises (2017)
- I. ANSI/TIA -758-B: Customer-Owned Outside Plant Telecommunications Infrastructure Standard. (2012)
- J. Fiber optic cable, wire and connectors shall be installed as indicated, in accordance with the manufacturer's written instructions, the applicable requirements of CEC and the National Electrical Contractors Association's "Standard of Installation", and in accordance with recognized industry practices to ensure that products serve the intended functions. As such, all of the following: National Fire Code (NFPA), California Electrical Code (CEC), California Building Code (CBC) & Local Codes shall be followed.

#### **1.05 QUALIFICATIONS**

- A. The contractor shall possess a California C7 or C10 license.
- B. The Contractor or Subcontractor shall be Corning certified to provide and install cable plant with 5 years documented experience.
- C. Contractor shall be located within 50 miles or less from the project site to support 2-hour response time.

#### **1.06 REFERENCES**

- A. See Division 27 05 00.

#### **1.07 SYSTEM REQUIREMENTS**

- A. Any new installations or existing system modifications shall seamlessly integrate into the site's existing data cable plan system.

#### **1.08 CONTRACTOR "SHOP DRAWINGS" DESIGN REQUIREMENTS**

- A. See section 27 05 00 for requirements.

#### **1.09 SUBMITTALS**

- A. See section 27 05 00 for requirements.

#### **1.10 DISTRICT STANDARDS**

- A. Coordinate all installations with DJUSD Facilities
  - 1. Fiber feed to each IDF shall be as follows:
    - a. Each MDF/IDF shall have a rack mount Fiber LIU shall be installed to receive the fiber optic backbone cable.

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- b. If existing MDF is to remain on the campus and no impact to existing fiber distribution, match type of fiber currently installed, typically 62.5-micron, 12 strand multi-mode fiber.
  - c. If an existing MDF is part of the project and requires rework or upgrade to more than 50% of the site's IDFs, all the IDFs shall be upgraded to a new fiber cable, 50 microns, OM4 multi-mode fiber with LC connectors. Elementary Schools shall have 6 strands to each IDF. Middle and High schools shall have 12 strands to each IDF.
  - d. If a new MDF is part of the project, each of the IDFs shall be fed with a new 12 strand, 50 micron, OM4 multi-mode fiber with LC connectors.
  - e. Voice feeders:
    - i. If the site's phone system has been converted to VoIP, voice feeders are no longer applicable.
    - ii. If the existing campus is on an analog voice PBX system, a 12-pair, or 25-pair Cat5 copper feeder shall be provided. The feeder shall be terminated on a patch panel on each end, each pair terminated on a RJ-45 gray Cat5 jack, center pin.
2. No gel filled copper cables shall be terminated in the MDF or the IDF.
3. For voice connectivity, Engineer shall confirm with owner what devices and/or equipment shall be connected to VOIP system, i.e. fax machines, elevators, handicap lifts, etc., which might require a separate analog pair from IDF where the special equipment terminates to the MDF where the VoIP switch is mounted.

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## **PART 2 – PRODUCTS**

### **2.01 DATA FIBER BACKBONE**

- A. All products shall be new and unused and shall be of manufacturer's current and standard production.
- B. Contractor shall confirm all equipment part numbers with the District prior to ordering equipment and updating submittals as required.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory operation.
- D. Product Availability
  - 1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.

### **2.02 CONDUIT AND RACEWAY**

- A. See division 27 05 00 for conduit and raceway requirements.

### **2.04 PATCH CORDS**

- A. See section 27 16 00 for requirements

### **2.05 LOW VOLTAGE ENCLOSURES AND PATHWAYS**

- A. See section 27 05 00 for additional requirements.

## **PART 3 – EXECUTION**

### **3.01 ACCEPTABLE INSTALLERS**

- A. The cable plant system shall only be installed by Contractors who are qualified to install, service and maintain the cable plant system.
- B. The Contractor (or subcontractor listed at time of bid) must have at least five (5) years' experience before the Bid Opening Date.

### **3.02 EXAMINATION**

- A. The Contractor shall be required to visit the installation site(s) prior to bidding the job. The Contractor acknowledges that the failure to visit the site(s) will not relieve the Contractor of the responsibility for observing and considering those conditions which a Contractor would have observed and considered during a site visit, estimating properly the difficulty and cost of successfully performing the Work or proceeding to perform the Work without additional cost to the District.
- B. The Contractor shall report any discrepancies between the Specifications, Drawings, and Site Examination prior to the Bid Opening Date.

### **3.03 PREPARATION**

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- A. The Contractor shall order all required parts and equipment upon receipt of approved product submittals.
- B. The Contractor shall verify the availability of power where required.

### 3.04 SHOP DRAWINGS

- A. See section 27 05 00 for requirements
- B. Submit drawings for review and approval by Project Manager.

### 3.05 INSTALLATION

- A. See 27 05 00 for additional routing requirements
- B. The cables will be routed to their respective Main Distribution Frame (MDF) or Intermediate Distribution Frame (IDF) utilizing the shortest path possible while maintaining right angles to the building structure.
- C. Contractor is required to adhere to the parameters in this section whether existing equipment has been placed by Contractor and/or others.
- D. Contractor will notify the District if any of the requirements cannot be met prior to bid.
- E. Voice copper backbone
  - 1. Terminations shall be T568B configuration unless otherwise specified.
  - 2. Labeling
    - a. Wiring termination locations shall be labeled to corresponding pairs at the MDF and IDF.
    - b. Cables shall be labeled no more than 3" back from each end of the termination point with a cable label that matches the patch panel labeling.
    - c. Contractor will provide tags, straps, and adhesive labels. These tags, straps, and adhesive labels shall be of high quality that will endure over time.
    - d. Handwritten labels are not acceptable.
    - e. Each pair shall have a unique label throughout the site. This would allow a cable management system to track each cable pair.
    - f. Labeling Scheme
      - 1) Closet labeling: 66-block or surface-mount quickport box shall be labeled with the destination MDF or IDF #, sequential feeder pair number only. The labeling itself shall be in a white background with black lettering.
- F. **Data Fiber Backbone**
  - 1. The District has standardized on materials that provide component quality and maintainability. Refer to the Appendix A at the end of this specification for pre-approved material.
  - 2. Fiber Optics Cable Installation and Testing.

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- a. Service loops shall be secured to backboard or rear of cabinet using a pre-manufactured fiber optic wheel with Velcro straps. If installed at rear of cabinet, the wheel shall be placed at a height that will not interfere with equipment to be installed in the cabinet.
- b. Fiber cables shall be securely mounted to the fiber enclosure using zip ties in at least two locations around the jacket to prevent cable twisting and movement. In addition, the Kevlar or strength member shall be bolted, tied, or securely fastened to the enclosure.
- c. Fibers strands shall be neatly organized in the enclosure with individual bundled paths from each cable to the bulkheads in which they are mounted.
- d. Fiber strands shall be made to rest in their final position without tension or stress of any kind.
- e. All spare optical ports and connectors shall have a dust cap in place to protect from the environment.
- f. Contractor shall provide and install blanks in unused spaces of the fiber enclosure.
- g. All unused optical ports on the LIU shall have protective covers that prevents dust and particles to enter the port.

### 3. Fiber Optics Labeling

- a. Fiber termination locations shall be labeled to corresponding fiber strands pairs at the MDF and IDF.
- b. The labeling scheme shall be submitted by the contractor for District / District representative approval prior to installation.
- c. Contractor is expected to provide tags, straps, and adhesive labels. These tags, straps, and adhesive labels shall be of high quality that will endure over time.
- d. Handwritten labels are not acceptable.
- e. Labeling requirements
  - 1) Cables shall be labeled approximately 12 inches back from the point where the cable enters the fiber enclosure with a cable label that identifies the origin and destination of the cable.
  - 2) Closet labeling; each connection shall be labeled denoting each strands number, origin and destination.
  - 3) The type (single-mode or multi-mode) of fiber optic cable used shall be clearly labeled on the fiber patch panel per drawn details.
  - 4) Color-coding shall conform to ANSI/TIA specifications.

### 4. Fiber Optics Testing

- a. All optical test equipment shall have current, traceable calibration certification.
- b. If fiber is supplied to Contractor by the district shall be tested before installation, while still

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on the shipping reel, using an optical time domain reflectometer (OTDR). The test results shall be compared to the manufacturers test results. A discrepancy of more than 1 dB on any fiber in either window indicates possible shipping damage and the fiber shall be returned to the supplier. The test results shall be maintained in a file for future reference.

- c. All fiber shall be tested after installation according to the Method A procedures described in ANST/TIA-568-C.
- d. Power meter test equipment shall produce a machine generated test report containing the minimum of the following test information:
  - 1) Contractor's Name
  - 2) Operator's Name
  - 3) Customer's location
  - 4) Closet Location
  - 5) Cable ID
  - 6) Test Summary – i.e. Pass/Fail
  - 7) Date and Time of test
  - 8) Test Standard
  - 9) Equipment serial numbers
  - 10) Length in Feet
  - 11) Test direction – i.e. MDF to IDF=A-B / IDF to MDF=B-A
  - 12) Wavelength
  - 13) Optical loss in dB
  - 14) Optical loss limit
  - 15) Reference setting
  - 16) Reference setting date and time

(Most bi-directional test sets will meet these criteria providing the operator enters the proper information. Contractor shall notify the project manager before testing if there is any question regarding this requirement)

- e. In addition to power meter testing, OTDR testing is to be performed in any location where the fiber is not continuous, i.e. coupled LC connectors (soft splice), fusion splice, and mechanical splice. When testing with an OTDR the contractor shall utilize a test lead or launch cable a minimum of 100 meters in length and a trail test cable a minimum of 100 meters in length. The contractor shall set a marker at the start and end of the tested cable on each test result and the difference in loss between the two markers shall be noted on the test report. The results of these tests (printed OTDR result power meter

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attenuation results) shall be provided by the installer as documentation of the quality of installation and as a baseline for future troubleshooting. The results shall be compared to the pre-installation test results for significant changes.

- f. The multi-mode cable shall comply with maximum individual fiber loss limits in accordance with ANSI/TIA-568-C Multimode, OM4.
- g. Aerial fiber cable mounting hardware shall be matched to the all dielectric self-supporting (ADSS) fiber cable exactly and be installed in accordance with mounting hardware and cabling manufacturers specifications.

### **3.06 WORKMANSHIP**

- A. Quality workmanship is a high priority for the District and the Contractor shall be held to a high-level of professional workmanship. Contractors unfamiliar with the District's standards shall familiarize themselves with the District's standards and requirements prior to beginning work.
- B. Comply with highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.
- C. Perform Work with persons experienced and qualified to produce workmanship specified.
- D. Maintain quality control over suppliers and Subcontractors.
- E. Quality of workmanship is considered important. The District's Project Manager will have the authority to reject Work which does not conform to the Drawings and Specifications.

### **3.07 CABLE**

- A. Design, layout, size, and plan new cable runs as required.
- B. All wire and cable passing thru metalwork shall be sleeved by an approved grommet or bushing.
- C. Conduit/raceway fill shall not exceed 40 percent of interior cross-sectional area.
- D. Identify all cables at terminations. Identification shall be made with an approved permanent label, machine generated 1/4" black letters on white tape (Brady or equal.)
- E. Underground cable shall be rated for use.
- F. Neatly dress and tie all cabling.

### **3.08 CONDUIT AND RACEWAY INSTALLATION**

- A.. Design, lay-out, size and plan new conduit and raceway systems as required.
- B. Install conduit and raceway in accordance with Division 27 05 00 requirements.

### **3.09 PENETRATIONS, CUTTING AND PATCHING, DEMOLITION, PAINTING**

- A. See section 27 05 00 for requirements

### **3.10 FIELD QUALITY CONTROL AND TESTING**

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- A. Upon reaching substantial completion, perform a complete test and inspection of the system. If found to be installed and operating properly, notify District of your readiness to perform the formal Test & Inspection of the complete system.
- B. Submit the Record Drawings (as-builts) to District for review prior to inspection.
- C. During the formal Test & Inspection (Commissioning) of the system, have personnel available with tools and equipment to inspect wiring, devices and system operation.
- D. If corrections are needed, the Contractor will be provided with a Punch-List of all discrepancies. Perform the needed corrections in a timely fashion.
- E. Notify District when ready to perform a re-inspection of the installation.

### **3.11 EQUIPMENT INSTALLATION CONFIGURATION AND TESTING**

- A. See section 27 05 00 for requirements

### **3.12 AS-BUILT DRAWINGS AND TEST RESULTS**

- A. See section 27 05 00 for requirements.

**END OF SECTION 27 13 00**

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## SECTION 27 15 00 COMMUNICATION HORIZONTAL INFRASTRUCTURE

### PART 1 GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  1. Pathways.
  2. UTP cabling.
  3. Coaxial cable.
  4. Multiuser telecommunications outlet assemblies.
  5. Cable connecting hardware, patch panels, and cross-connects.
  6. Telecommunications outlet/connectors.
  7. Cabling system identification products.
  8. Cable management system.
- B. Related Sections:
  1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
  2. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices

#### 1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International
- B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector
- F. LAN: Local area network.
- G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications' outlet/connectors.
- H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- I. RCDD: Registered Communications Distribution Designer.

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- J. UTP: Unshielded twisted pair

## 1.4 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
  1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
  2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
  3. Bridged taps and splices shall not be installed in the horizontal cabling.
  4. Splitters shall not be installed as part of the optical fiber cabling.
- B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect.
  1. All data station cabling shall be universal, Cat6A minimum. No Cat6A cable shall exceed 0.250" diameter. Specific cables and jack colors are as follows:
    - a. Voice cable: Orange
    - b. Voice jack: Orange
    - c. Data cable: Blue
    - d. Data jack: Blue
  2. No gel filled copper cables shall be terminated in the MDF or the IDF. Wireless access point locations, 1 for each typical classroom shall be universal, Cat6A. Specific cables and jack colors are as follows:
    - a. Cable: Black
    - b. Jack: Black
  4. Classroom connectivity:
    - a. Dedicated hardwired data drops in classrooms.
      - i. 4 ea. hardwired data drops per classroom for teacher and student usage.
      - ii. 1 ea. data drop for teacher phone.
    - b. Each wall shall have 2 ea. double gang boxes with a 1" conduit feeding into the

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double gang box.

i. During construction one of the boxes will be occupied with 1 ea. data drop.

ii. On each wall, one empty in-wall double gang box with blank face plate and 1" conduit to accessible above ceiling are for future use (voice/data/AV).

c. Data outlets shall be designed to be adjacent (within 18") of an electrical outlet, except for wireless access points and wall phones.

d. Data outlets behind or at each TV / LCD / Projector location for a screen sharing devices (i.e. such as an Apple TV) or similar devices. If project budget does not allow TVs / Projectors as part of the project, the pathway and data drops shall be installed as part of the project. See 274100 for quantity and type.

e. 1 ea. hard wired data drop for lighting control system if it is connected to the network. Wireless connections not acceptable. If reliant on PoE power, proper coordination for PoE switch port loads needs to be coordinated with ITS.

f. Environmental controls/HVAC Thermostats, if it is connected to the network, wireless connections are not acceptable. If reliant on PoE power, proper coordination for PoE switch port load needs to be coordinated with ITS.

g. Electronic door security, if it is connected to the network, wireless connections are not acceptable. If reliant on PoE power, proper coordination for PoE switch port load needs to be coordinated with District ITS.

#### 5. Wireless data connectivity:

a. Each typical classroom shall have two wireless access point data drop connections installed, typically at the center of room.

b. Each of the access point data drops shall have a service loop of 20' installed directly above the ceiling where the access point is installed. The service loop shall be neatly coiled and secured to structure above.

c. Design shall indicate that the district is to provide the access point hardware. Design shall indicate that the contractor is to install the district provided hardware. Coordinate with District's ITS Department. Ph: 530-757-5300 x117

d. The District will program the access points. Coordination for this work will happen through the ITS Department.

e. Engineer must work with ITS for placement and exact locations of WAPS.

f. Wireless Access Point requirements for larger gathering areas (MP rooms, cafeterias, Gyms, Performing Art Centers, Student Unions, outdoor learning areas and other not typical instruction environments, etc.) will be developed in consultation with the Facilities and ITS Departments to meet space utilization requirements. Engineer shall

## 1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards

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in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

## 1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Retain subparagraph below for coaxial cable. Installation data for UTP and optical fiber cabling are specified in the referenced TIA/EIA standards.
  - 1. For coaxial cable, include the following installation data for each type used:
    - a. Nominal OD.
    - b. Minimum bending radius.
    - c. Maximum pulling tension.
- C. Shop Drawings:
- D. Retain one of first two subparagraphs below.
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  - 3. Cabling administration drawings and printouts.
  - 4. Wiring diagrams to show typical wiring schematics, including the following:
    - a. Cross-connects.
    - b. Patch panels.
    - c. Patch cords.
  - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
  - 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
    - a. Vertical and horizontal offsets and transitions.
    - b. Clearances for access above and to side of cable trays.
    - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
    - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
    - e. Retain first paragraph below when workstation outlet faceplates have critical features needing hands-on appraisal.
    - f. Remaining paragraphs are defined in Division 01 Section "Submittal Procedures" as "Informational Submittals."
- E. Qualification Data: For [Installer,] qualified layout technician, installation supervisor, and field inspector.
- F. Source quality-control reports.
- G. Retain first paragraph below if Contractor is responsible for field quality-control testing and inspecting.
- H. Maintenance Data: For splices and connectors to include in maintenance manuals.
- I. Retain paragraph below for PC-based cabling administration systems.

## 1.7 QUALITY ASSURANCE

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- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings [and Cabling Administration Drawings], [Cabling Administration Drawings, and field testing program development] by an RCDD.
  - 2. Installation Supervision: Installation shall be under the direct supervision of [Registered Technician] [Level 2 Installer], who shall be present at all times when Work of this Section is performed at Project site.
  - 3. Delete subparagraph below if Contractor performs field quality control.
  - 4. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
  - 5. Retain first paragraph below if Contractor or manufacturer selects testing agency or if Contractor is required to provide services of a qualified testing agency in "Field Quality Control" Article. Qualification requirements are in addition to those specified in Division 01 Section "Quality Requirements," which also includes the definition for "NRTL" (nationally recognized testing laboratory).
- B. Testing Agency Qualifications: An NRTL.
  - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: [25] <Insert value> or less.
  - 2. Smoke-Developed Index: [50] [450] <Insert value> or less.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.
- E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- F. Grounding: Comply with ANSI-J-STD-607-A.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
- B. Retain one or both of first two subparagraphs below.
  - 1. Test optical fiber cables to determine the continuity of the strand end to end. Use [optical fiber flashlight] [or] [optical loss test set] <Insert test>.
  - 2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.
  - 3. Test each pair of UTP cable for open and short circuits.

## 1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## 1.10 COORDINATION

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- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.
- C. Services in this article may not be allowed for publicly funded projects.
- D. Retain this article for computer-based, special-purpose cabling administration software.

## **PART 2 PRODUCTS**

### **2.1 PATHWAYS**

- A. General Requirements: Comply with TIA/EIA-569-A. Refer to Section 270500 for VUSD requirements for approved parts list and additional information.
- B. Retain first paragraph below if cable support brackets are used in communications equipment room.
- C. Cable Support: Unistrut Corp. "J" hook hanger, NRTL labeled for support of Category 6A cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
  - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
  - 2. Lacing bars, spools, J-hooks, and D-rings.
  - 3. Straps and other devices.
- D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used, no exceptions..
  - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

### **2.2 BACKBOARDS**

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels.

### **2.3 UTP CABLE**

- A. Refer to Section 270500 for DJUSD requirements for approved parts list and additional information.
  - 1. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and CEC for the following types:
    - a. Communications, General Purpose: Type CM or CMG; [or MPP, CMP, MPR, CMR, MP, or MPG].
    - b. Communications, Plenum Rated: Type CMP [or MPP], complying with NFPA 262.
    - c. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.

### **2.4 UTP CABLE HARDWARE**

- A. Refer to Section 270500 for DJUSD requirements for approved parts list and additional information.

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## 2.5 OPTICAL FIBER CABLE & HARDWARE

- A. Refer to Section 270500 for DJUSD requirements for approved parts list and additional information.
- B. Description: Consolidation points shall comply with requirements for cable connecting hardware.
  - 1. Number of Terminals per Field: One for each conductor in assigned cables..
  - 2. Number of Connectors per Field:
    - a. One for each four-pair UTP cable indicated
    - b. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.
  - 3. Mounting: Recessed in ceiling, Wall.
  - 4. NRTL listed as complying with UL 50 and UL 1863.
  - 5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

## 2.6 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

## 2.7 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

## 2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. See Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.
- F. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- G. Cable will be considered defective if it does not pass tests and inspections.
- H. Prepare test and inspection reports.

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## **PART 3 EXECUTION**

### **3.1 ENTRANCE FACILITIES**

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

### **3.2 WIRING METHODS.**

- A. Wiring Method: Install cables in raceways except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### **3.3 INSTALLATION OF PATHWAYS**

- A. Coordinate cable connection hardware installations and specialty arrangements with layout drawings and with requirements specified for communications equipment rooms. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
  - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
  - 2. Install cable trays to route cables if conduits cannot be located in these positions.
  - 3. Secure conduits to backboard when entering room from overhead.
  - 4. Extend conduits [3 inches (76 mm)] <Insert dimension> above finished floor.
  - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

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### 3.4 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. MUTOA shall not be used as a cross-connect point.
  - 5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
    - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
    - b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.
  - 6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
  - 10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  - 12. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
  - 13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
  - 1. Comply with TIA/EIA-568-B.2.
  - 2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
  - 1. Comply with TIA/EIA-568-B.3.
  - 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- E. Open-Cable Installation:
  - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  - 2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than [60 inches (1524 mm)] apart.
  - 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Outdoor Coaxial Cable Installation:
  - 1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install

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- corrosion-resistant connectors with properly designed O-rings to keep out moisture.
- 2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

### 3.5 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect

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grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for [Class 2] [Class 3] [Class 4] level of administration, [including optional identification requirements of this standard].
- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, [backbone pathways and cables,] [entrance pathways and cables,] terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- G. Cable and Wire Identification:
  - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
  - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.
  - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.

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Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
1. Cables use flexible vinyl or polyester that flex as cables are bent.

### 3.8 FIELD QUALITY CONTROL.

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
  1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
  2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
  3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  5. Optical Fiber Cable Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    - b. Link End-to-End Attenuation Tests:
      - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
      - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
  6. UTP Performance Tests:
    - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
      - 1) Wire map.
      - 2) Length (physical vs. electrical, and length requirements).
      - 3) Insertion loss.
      - 4) Near-end crosstalk (NEXT) loss.
      - 5) Power sum near-end crosstalk (PSNEXT) loss.
      - 6) Equal-level far-end crosstalk (ELFEXT).
      - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
      - 8) Return loss.
      - 9) Propagation delay.

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- 10) Delay skew.
7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.
8. Retain first subparagraph below when cable is used for broadband closed-circuit television applications. Revise to suit tests to verify cable performance for other systems using coaxial cable.
9. Coaxial Cable Tests: Conduct tests according to Division 27 Section "Master Antenna Television System."
10. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
  - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
  - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- D. See Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train District's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

**END OF SECTION 27 15 00**

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## SECTION 27 16 00 COMMUNICATIONS CONNECTING CORDS

### PART 1 - GENERAL

#### 1.1 GENERAL

- A. This section details product and execution requirements for Communications Connecting Cords, Devices & Adapters.
- B. Included are: 1. 4-pair Modular Patch Cords 2. Multimode Fiber Optic Patch Cords 3. Single-mode Fiber Optic Patch Cords
- C. Quantities and lengths (if applicable) for each item shall be as detailed in the Execution part of this Section.

#### 1.2 RELATED WORK

- A. Refer to Section 27 05 00 "Common Work Results for Communications", which identifies related specification sections in this and other Divisions (if applicable).

#### 1.3 REFERENCES & STANDARDS

- A. Refer to Section 27 05 00 "Common Work Results for Communications", which identifies pertinent References & Standards.

#### 1.4 DEFINITIONS AND ABBREVIATIONS

- A. Refer to Section 27 05 00 "Common Work Results for Communications", which provides information on Definitions and Abbreviations used in this and related sections.
- 1.5 WORK BY OWNER A. Refer to Section 27 05 00 "Common Work Results for Communications", which identifies Work by the Owner affecting the sub-system(s) covered by this section.

#### 1.6 SUBMITTALS

- A. Refer to Section 27 05 00 "Common Work Results for Communications", which provides general guidelines for product and/or installation information to be submitted by the contractor.

#### 1.7 QUALITY ASSURANCE

- A. Refer to Section 27 05 00 "Common Work Results for Communications", which identifies general quality assurance requirements for the project.

### PART 2 - EXECUTION 2.1 GENERAL

- A. Furnish loose materials per owner/design-team direction. Obtain written confirmation by an authorized representative of NYU IT for all loose materials furnished.
- B. Prior to Construction, confirm connector types, length and quantities with Owner Design team, Network Integration Contractor, Telephony Integration Contractor, Security Integration Contractor, AV Integration Contractor, Wi-Fi Integration Contractor, RFID Integration Contractor, Philips Wi-Fi Integration Contractor and BMS Integration Contractor. For purposes of bidding, consider requirements as detailed below.

#### 2.2 QUANTITIES & LENGTHS

- A. Contractor to furnish and install all patch cords required to connect to the active data network equipment. Both at the MDF/IDF sides as well as the patch cords at the outlet locations.

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1. Each cable of 12 strand fiber shall have 12 ea. twin connector (6 ea. for MDF side / 6 ea. for IDF side) patch cords, LC/LC connectors to be able to activate all strands of installed fiber optic cable.
2. Each Cat6 Cable Drop shall have a patch cord at the head end and a patch cord at the station end.
3. 100% At head end and Station end patch cord to drop.
4. Contractor to provide 25% Spare patch cords in addition to the 1 for 1 cords to be provided.

B. All quantities and colors shall be coordinated prior to order - confirm connector types, length and quantities with district facilities, Network Integration Contractor, Telephony Integration Contractor, Security Integration Contractor, and BMS Integration Contractor four (4) week prior to expected installation date to ensure proper colors, lengths, and quantities are on hand.

**END OF SECTION 27 16 00**

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## SECTION 27 51 23 INTERCOM SYSTEM

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

- A. Division 27 Contractor shall furnish and install a complete Intercom System as shown on the Drawings and as specified herein. Provide all accessories and equipment as necessary for a complete system.
- B. Master stations shall have door lock release capabilities.

#### 1.02 QUALITY ASSURANCE

- A. All equipment shall be UL listed and labeled and in accordance with applicable NEMA and ANSI Standards.

#### 1.03 SUBMITTALS

- A. For Review:
  - 1. Product data sheets of all components
  - 2. Wiring Diagrams
- B. To be included in Record and Information Manuals:
  - 1. One (1) copy of each approved submittal
  - 2. Test results
  - 3. Certificate of System Completion

#### 1.04 MANUFACTURERS

- A. Intercom System
  - 1. CareHawk® CH1000 Life Safety Communication Platform

#### 1.05 DISTRICT REQUIREMENTS

- A. If the classroom has a suspended, drop-in ceiling type, preference is to install a ceiling IP speaker that fits in the ceiling grid.
- B. If speaker is unable to be installed in ceiling wall mounting is acceptable. Place speaker and clock adjacent to each other at similar height. Separate clock and speaker by framing stud bay.
- C. All new speakers shall be IP based and terminate to intercom IP gateways units.
- D. If the contract includes the upgrade of the intercom system to an IP platform, ALL speakers (interior/exterior) at site, regardless of if the building/rooms are part of the modernization project, shall be connected to new intercom IP system. Appropriate gateways (type and quantity) shall be specified to allow existing remaining analog speakers to be individually programmed for bell tone as well as individually paged.
- E. All occupied areas shall have a dedicated bi-directional intercom speaker.
- F. Exterior speakers shall be located to provide adequate exterior site coverage. Areas such as bus drop-offs, playgrounds/fields, interior court yards, etc. shall all have coverage. Speakers shall not exceed 60dB at property line.

### PART 2 - EXECUTION

#### 2.01 INSTALLATION

- A. Division 27 Contractor shall install Intercom System as shown on the Drawings in accordance with Manufacturer's written instructions.
- B. Coordinate exact wiring requirements with Equipment Manufacturer. Coordinate interface requirements to card key system in field.

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- C. Provide conduit stub ups from each outlet location to above accessible ceiling space. Provide continuous conduits across exposed areas or areas of inaccessible ceilings. Provide conduits between isolated areas of accessible ceilings to provide a continuous pathway for wiring from main equipment location to each device.

## **2.02 TESTING**

- A. Division 27 Contractor shall provide a complete functional test of all components in accordance with Manufacturer's recommendations.
- B. Operate system for a minimum of seven (7) consecutive days with no problems before final acceptance by Owner.
- C. Refer to 26 08 40, "Electrical Tests, Adjustments, Inspection."

## **2.03 EQUIPMENT DEMONSTRATION**

- A. After all system tests have been completed, schedule an instruction period with the Owner. Instruction to be provided by Manufacturer's authorized field technician.
- B. Instruction shall include:
  - 1. Location of all components of the system and explanation of their function
  - 2. Demonstration of equipment
  - 3. Maintenance and repair procedures
  - 4. Programming procedures
  - 5. Review of documents in Record and Information Manuals
- C. Division 27 Contractor shall have all participants sign the Certificate of System Completion in Section 26 00 99, "Requirements for Contract Completion."

**END OF SECTION 27 5123**

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**27 52 35**  
**ASSISTIVE LISTENING SYSTEM**

**PART 1 - GENERAL**

**1.1 WORK INCLUDED:**

- A. Provide an installed FM Assistive Listening System in the assembly spaces.

**1.2 RELATED WORK SPECIFIED ELSEWHERE:**

- A. Due to the nature of the project, this section may relate directly to, or requires coordination with all sections of the Contract Documents. Special attention should be given to:
  - 1. Section—Electrical General Requirements
  - 2. Section 27 41 00 - Audio Video System

**1.3 QUALITY ASSURANCE:**

- A. All materials shall comply with applicable standards of the Underwriters Laboratories Inc.

**1.4 CONTRACTOR SUBMITTALS:**

- A. Shop drawings and catalog data submittals shall be made in accordance with Section, "Contractor Submittals." Submit sufficient information to indicate the scope and quality of the Assistive Listening System.
  - 1. Block diagram showing system relationships of major components and quantities and interconnecting cable requirements.
  - 2. Plans showing equipment location and conductor requirements.
  - 3. Equipment outlet devices and special mounting details.
  - 4. Wiring diagrams showing terminal identification for field-installed wiring.
  - 5. Catalog literature with component specifications.

**1.5 DESCRIPTION:**

- A. Work under this section includes all equipment, labor, and materials necessary to furnish and install a complete assistive listening system.
- B. The assistive listening systems shall be a Frequency Modulated Radio Transmission system.
- C. The portable system shall utilize a belt pack transmitter with headset microphone.
- D. The ALS systems shall be capable of operating over 3 separate channels simultaneously.
- E. Receivers shall be provided at a rate of 4% of the total seating capacity of each room. Refer to architectural drawings for maximum room capacity. Quantity shall be as indicated on drawings.

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F. Features:

1. Multi Purpose-No seating restrictions, 1,500 ft system range
2. Receivers are pre-tuned, users control their own volume
3. Easily expanded no limit to number of users.
4. Excellent sound quality, free from interference
5. Automatic Gain Control
6. Frequency Synthesized, phase locked loop tuning
7. Can accept either balanced or unbalanced inputs
8. Input attenuation and low frequency attenuation switches
9. LED power and audio level indicators

## PART 2 - PRODUCTS

### 2.1 GENERAL:

- A. All equipment shall be the standard catalogued products of a single manufacturer. The catalog numbers of the following equipment are Telex:
- B. Portable Transmitter
  1. The portable FM transmitter shall be capable of broadcasting on 17 channels and be frequency agile.
  2. The transmitter shall have a SNR of 58 dB or greater.
  3. The transmitter shall operate at 072 MHz
  4. The Telex PST-170 is specified:
    - a. HM-2 Head worn microphone
    - b. NiMH rechargeable batteries.
    - c. Universal Antenna Kit
    - d. Universal Rack Mounting Kit
- C. Portable Receiver
  1. The FM receiver shall be capable of receiving on 17 wide band channels with a SNR of 58dB or greater.
    - a. The device shall be able to be locked on a single channel.
    - b. The receiver shall be capable of seeking channels.
    - c. The device shall have an adjustable squelch.
    - d. The device shall have an audio frequency response of 100 Hz to 10 KHz,  $\pm 3$  dB.
    - e. The device will incorporate a stereo headset jack that allows the user to plug in either a mono or stereo headset.
    - f. The device shall incorporate an LCD display that indicates channel, battery level, low battery, battery charging, and RF signal strength.

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- g. The receiver shall be able to function in both DX and Local mode.
- h. The unit shall operate off of 2 AA batteries. The receiver shall incorporate automatic battery charging circuitry for recharging of NiMH batteries.
- i. The Telex SR-400 is specified.
- 2. The FM receivers shall be recharged using a charging carrying case for up to 8 units.
  - a. Unit Charging Case
    - i) Quantity as required for each unit.
- 3. The FM receivers shall each be equipped with Ear Speakers.
  - a. HED-2 is specified.
  - b. NL-4S Neck Loop
    - i) Quantity as required for each unit.
- 4. Receivers shall be equipped with NiMH rechargeable batteries.
  - a. Quantity as required for each unit.
- D. Provide sound reinforcement wall plaques per ADA requirements to indicate equipment available for the hearing impaired.
  - 1. Verify location with general contractor prior to installation. Use the "international symbol of access for the hearing impaired".

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. The contractor shall supply all equipment required to provide a complete and functional assistive listening system.
- B. The assisted listening system shall be an integral part of the sound reinforcement system for the required spaces.

#### **3.2 TESTS AND ADJUSTMENTS**

- A. Under completion of the installation of all equipment and when same is in full operating condition, the contractor shall perform the initial completion tests and adjustments specified hereinafter. The Contractor is responsible to provide all necessary instruments, equipment, material, and labor necessary to complete the tests.

#### **3.3 TRAINING:**

- A. Prior to establishing a training schedule, contractor will verify operational status of system with owner's rep.
- B. Owner personnel will be trained in the operation of the Assistive Listening System.
- C. Training will be conducted no less than two times, four hours each. An initial familiarization and a follow up for detailed questions.

#### **3.4 WARRANTY**

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- A. The manufacturer shall guarantee the system and components to be free from defects of material and workmanship for a period of two years from the date of final acceptance by the owner.

END OF SECTION

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## **Wireless Clock System Section 27 53 13**

### **1 GENERAL**

#### **1.01 SUMMARY OF WORK**

A. This Section specifies materials and accessories for a wireless clock system.

B. Section Includes:

1. Master clock;
2. Repeaters
3. Secondary analog clock;
4. Secondary digital clock.
5. Elapsed timer control panel;

#### **1.02 RELATED REQUIREMENTS**

A. Division 27

#### **1.03 REFERENCE STANDARDS**

A. Federal Communications Division (FCC)

1. Part 15 - Code of Federal Regulations.

B. National Fire Protection Association (NFPA).

1. NFPA 70E-[2012], Standard for Electrical safety in the Workplace.

C. Underwriter's Laboratories (UL).

1. UL

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

A. Co-ordination: Co-ordinate work of this Section with communications and electronics work and with work of other trades for proper time and sequence to avoid construction delays.

#### **1.05 ACTION AND INFORMATIONAL SUBMITTALS**

A. Make submittals in accordance with Contract Conditions and Section 01 33 00 - Submittal Procedures.

B. Product Data: Submit product data including manufacturer's literature for clock system materials and accessories, indicating compliance with specified requirements and material characteristics.

1. Submit list on clock system manufacturer's letterhead of materials and accessories to be incorporated into Work.
2. Include product name.
3. Include preparation instructions and recommendations, installation methods, and storage and handling requirements.

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4. Include contact information for manufacturer and their representative for this Project.

C. Shop Drawings: Submit shop drawings with information as follows:

1. Diagram of proposed system showing system platform appliance, communication pathway, and schedule of individual device locations.
2. Indicate integration with the Owner's network and servers. Include line diagram of network relationships.
3. Show system power requirements.

D. Samples:

1. Submit one sample of each type of device used on project. Samples will be returned Contractor for incorporation into the Work after Consultant's review.

E. Test Reports:

1. Submit evaluation and test reports or other independent testing agency reports showing compliance with specified performance characteristics and physical properties.

F. Subcontractor Experience: Submit verification of communication and electronics subcontractor's experience.

G. Manufacturer's Authorization: Submit verification of communication and electronics subcontractor's authorization from clock system manufacturer to perform Work of this section.

## **1.06 CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: Supply maintenance data for clock system for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **1.07 QUALITY ASSURANCE**

A. Communications and Electronics Subcontractor Quality Assurance:

1. Work experience of [3] years minimum with work similar to work of this Section.
2. Manufacturer's authorization to perform work of this section.

B. Supplier's Accreditation: Use only suppliers accredited by clock system manufacturer.

C. Supplier's Maintenance Requirements:

1. Ensure local supplier has adequate facility for storage of spare parts for clock system.

## **1.08 DELIVERY STORAGE AND HANDLING**

A. Delivery and Acceptance Requirements:

1. Deliver material in accordance with Section 01 61 00 - Common Product Requirements.

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2. Deliver materials and accessories in clock system manufacture's original packaging with identification labels intact and to suit project.
3. Ensure clock system materials are not exposed to moisture during delivery.
4. Replace damaged clock system materials.

B. Storage and Handling Requirements: Store materials off ground in dry location and protected from exposure to fumes and harmful weather conditions and at temperature conditions recommended by manufacturer.

1. Store in original packaging until installed.

## **1.09 WARRANTY**

- A. Project Warranty: Refer to Contract Conditions for project warranty provisions.
- B. Manufacturer's warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and not intended to limit other rights Owner may have under Contract Conditions.
- C. Warranty period: [2] years commencing on Date of Purchase.

## **1.10 DISTRICT REQUIREMENTS**

- A. Current district standard is Sapling.
- B. Any clocks installed in the future shall be IP clocks.
- C. Main administration area should have a digital IP type clock installed.
- D. MP/Gym/Cafeteria areas shall have 16" clock with a cage to protect the clock from objects.
- E. If the contract includes the upgrade of the clocks to an IP platform, ALL clocks (interior/exterior) at site, regardless of if the building/rooms are part of the modernization project, shall be connected to new IP clock system. Appropriate hardware or software (type and quantity) shall be specified to allow existing remaining clocks to be tied into the new IP clock platform.

## **2 PRODUCTS**

### **2.01 MANUFACTURER**

- A. Manufacturer: Sapling Inc., 670 Louis Drive, Warminster, Pennsylvania 18974, USA, Phone: 1-215-322-6063, URL: www.sapling-inc.com.

### **2.02 SYSTEM REQUIREMENTS**

- A. Ensure clock system components are designed to operate as a wireless clock system and as part of complete system including "fail-proof" design to ensure power interruption does not cause system failure.
- B. Ensure system can work in conjunction with existing wiring.
- C. Ensure system synchronizes all clocks and devices to each other.
- D. Ensure system does not require FCC licensing.

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- E. Ensure system works in [915-928 MHz] [2.4 GHz] frequency range.
- F. Ensure system uses frequency-hopping technology.
- G. Ensure system is capable of correcting clocks immediately upon receipt of wireless signal.
  - 1. Analog and digital clocks automatically correct themselves on receipt of wireless signal.
  - 2. Include built-in closed-loop system in analog clocks capable of allowing clocks to detect position of hands and bring clocks to correct time even if clocks are manually altered.
  - 3. Ensure analog clocks have diagnostic function capable of allowing user to view how long since clock received wireless signal.
  - 4. Ensure analog clocks are capable of functional tests of electronics and gears.
- H. Ensure each individual product is bench tested at manufacturer's facility.
  - 1. Random testing is unacceptable.
- I. Ensure each product is designed, assembled and tested in the United States of America.
- J. Basis of Design: Sapling Inc., Wireless Clock System.

## **2.03 MASTER CLOCK**

- A. Master Clock Type 1: To UL and cUL 863.
  - 1. Ensure master clock includes 10 pre-programmed (S)NTP backup addresses.
  - 2. Ensure master clock is capable of receiving (S)NTP time signal via Ethernet.
  - 3. Ensure master clock is capable of receiving digital signals through RS485 connection.
  - 4. Ensure master clock is capable of correcting secondary clocks for Daylight Saving Time
  - 5. Ensure master clock is capable of customizing Daylight Saving Time, in the event of international use or a change in government regulations.
  - 6. Ensure master clock is capable of outputting RS485 signals.
  - 7. Ensure master clock has two clock circuits capable of outputting signals including:
    - a. 59 minute correction;
    - b. 58 minute correction;
    - c. National Time or Rauland correction;
    - d. Once a day pulse;
    - e. Rauland digital correction.
  - 8. Communications Interface: Ensure master clock system is capable of being programmed remotely through online interface accessible through LAN and compatible with Microsoft Internet Explorer and Mozilla Firefox web browsers.

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a. Ensure interface includes functions as follows:

- 1) Allow users to schedule bells and other events;
- 2) Display features;
- 3) Show IP settings;
- 4) Show other master clock settings;
- 5) Set time and date;
- 6) Download or upload master clock settings;
- 7) Configure e-mail alerts for various instances.

9. Display: Two row, 20 character LED and backlit LED display and 2 x 8 inch rubber keypad for operator programming.

10. Optional relays: Include [ ] relays to ensure master clock is capable of utilizing 4-8 zones that can be used for scheduling facility systems as follows:

11. Allow for programming of master clock through 16 button rubber tactile keypad or built-in web interface.

12. Ensure master clock can contain up to 800 events.

13. Ensure master clock can contain up to 255 schedule changes.

14. Clock System: Wireless with transmitter to FCC, Part 15.

a. Transmitter: Capable of transmitting data to SAL(G) wireless analog and SBL(G) wireless digital clocks, and receiving signal from (S)NTP time server

b. Automatic bi-annual Daylight Savings Time changes.

19. Countdown for Digital Clocks: Ensure master clock is capable of having digital clocks counting down time between events.

20. Ensure master clock has internal battery to save settings and operate internal real-time clock for 10 years.

21. Input Voltage: 85 V AC – 264 V AC, 50/60 Hz.

22. Basis of design: Sapling Inc., SMA 3000 Series Master Clock.

B. Master Clock Type 2: To UL and cUL 863.

1. Ensure master clock includes 10 pre-programmed (S)NTP backup addresses.
2. Ensure master clock is capable of receiving (S)NTP time signal via Ethernet.
3. Ensure master clock is capable of receiving digital signals through RS485 connection.
4. Ensure master clock is capable of correcting secondary clocks for Daylight Saving Time
5. Ensure master clock is capable of customizing Daylight Saving Time, in the event of international use or a change in government regulations.

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6. Ensure master clock is capable of outputting RS485 signals.
7. Ensure master clock has two clock circuits capable of outputting signals including:
  - a. 59 minute correction;
  - b. 58 minute correction;
  - c. National Time or Rauland correction;
  - d. Once a day pulse;
  - e. Rauland digital correction.
8. Clock System: Wireless with transmitter to FCC, Part 15.
9. Ensure system is capable of interfacing with GPS, Internet and intranet systems.
10. Allow for programming of master clock through two push button switches on front panel.
11. Ensure master clock is capable of interfacing with both analog and digital secondary clocks.
12. Communications Interface: Ensure master clock system is capable of being programmed remotely through online interface accessible through LAN and compatible with Microsoft Internet Explorer and Mozilla Firefox web browsers.
  - a. Ensure interface includes functions as follows:
    - 1) Display features;
    - 2) Show IP settings;
    - 3) Show other master clock settings;
    - 4) Set time and date;
    - 5) Download or upload master clock settings;
    - 6) Configure e-mail alerts for various instances.
13. Ensure master clock has internal battery to save settings and operate internal real-time clock for 10 years.
14. Input Voltage: 85 V AC – 264 V AC, 50/60 Hz.

## 2.05 SECONDARY CLOCKS

A. Analog Clocks: To UL and cUL 863, designed for wireless system with fully automatic plug and play capability.

1. Ensure secondary clock is capable of receiving wireless signals from master clock.
2. Ensure each secondary clock works as an RF signal repeater, establishing a Mesh Network.
3. Clock display: [12] [24] hour [white face with black numbers] [black face with white numbers] [custom [ ] ] [custom logo [ ] ].
  - a. Size: [Round [9] [12] [16] inches] [Square [9 x 9] [12 x 12] inches].

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4. Ensure analog secondary clock is capable of receiving Sapling wireless signals every two (2) or four (4) hours for battery models and every minute for 24 V / 110V model.

5. Materials:

- a. Dial: Polystyrene
- b. Case: Shallow profile, smooth surface SlimLine ABS
- c. Crystal: Shatter-proof, side-molded, polycarbonate.

6. Hand tolerance:

- a. Hour and minute hands:  $\pm 1/4$  minute.
- b. Second hand:  $\pm 1/2$  minute.

7. Power Requirements: [Battery operated] [24V AC] [24 V DC] [110 V AC, 60 Hz] [220 V AC, 50 Hz].

a. Batteries: 2 "D" cell batteries.

1) Basis for design: Duracell Procell "D" Cell batteries.

8. Basis of design: Sapling Inc., [SAL(G) Series Wireless Round Clock] [SAL(G) Series Wireless Square Clock].

B. Digital Clocks: To UL and cUL 863, designed for wireless system.

- 1. Ensure secondary clock is capable of receiving wireless signals from master clock.
- 2. Ensure each secondary clock works as an RF signal repeater, establishing a Mesh Network.
- 3. Display: High-efficiency red LED numeral display with [4] [6] digits.
  - a. Display size: [2.5] [4.0] inches
  - b. Format: [12] [24]
  - c. Brightness: Ensure display has four levels of brightness adjustment.
  - d. Bezel:

## 2.06 ACCESSORIES

A. Elapsed Timer Control Panel: Interface capability with [SBL(G) 3200 Series] [SBL(G) 3300 Series] digital clock.:

- 1. Capable of working with 4-digit or 6-digit digital clocks.
- 2. Count up functionality from 00:00:00 to 99:59:59.
- 3. Programmable countdown functionality starting at 99:59:59.
- 4. Customizable backlit buttons.
- 5. Ensure timer is capable of controlling digital clock functions.
- 6. Ensure timer is capable of activating relay at completion of count down on the digital clock (SBL 3300 Series only)

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7. Basis of design: Sapling Inc., Digital Elapsed Timer.

B. Signal and Control Circuits: Manufacturer's recommended stranded, single conductors or twisted pair cable.

C. Data Circuits: Category 5 minimum, twisted pair cable.

## **2.07 SOURCE QUALITY CONTROL**

A. Ensure clock system components and accessories are supplied or approved in writing by single manufacturer.

## **2.08 PRODUCT SUBSTITUTIONS**

A. Substitutions: [In accordance with Section 01 23 13 - Product Substitution Procedures] [No substitutions permitted].

## **3 EXECUTION**

### **3.01 INSTALLERS**

A. Use only installers with [3] years minimum experience with work similar to work of this Section.

B. Ensure all clock system components are installed by single communications and electronics subcontractor.

### **3.02 EXAMINATION**

A. Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for clock system installation in accordance with manufacturer's written recommendations.

1. Visually inspect substrate in presence of Consultant.

2. Ensure surfaces are free of snow, ice, frost, grease and other deleterious materials.

3. Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

B Start of clock system installation indicates installer's acceptance of substrate installation conditions.

### **3.03 INSTALLATION**

A. Install wireless clock system in accordance with manufacturer's written recommendations and in accordance with NFPA 70E.

B. Integrate clock system with Owner's electrical and communications network.

C. Install wiring in accordance with requirements of local Authority Having Jurisdiction.

1. Do cabling in accordance with Section [27 15 00 - Communications Horizontal Cabling].

D. Conceal wiring except in unfinished spaces and as approved in writing by Consultant.

E. Install clocks only after painting and other finish work is completed in each room.

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F. Install clocks and other devices square and plumb.

### **3.04 FIELD QUALITY CONTROL**

A. Field Inspection: Coordinate field inspection in accordance with Section [01 45 00 - Quality Control].

### **3.05 SYSTEM STARTUP**

A. At completion of installation and before final acceptance, turn on equipment and ensure equipment is operating properly, and clock system devices and components are functioning.

B. Evaluate and test each device in clock system on room-by-room basis using factory-trained technicians.

1. Fix or replace devices which fail test or are functioning incorrectly.

2. Submit evaluation and report showing results of room-by-room tests and overall system compliance within 3 days of testing being carried out.

### **3.07 DEMONSTRATION AND TRAINING**

A. Arrange system demonstration and training session for Owner's operation and maintenance personnel.

1. Allow Owner and Consultant [7] days minimum advance notice before training session.

B. Break down system demonstration and training session into logical segments for Owner's operations and maintenance personnel.

C. Train Owner's maintenance personnel in procedures and schedules involved in operating, troubleshooting, servicing, and preventative maintenance of clock system.

### **3.08 SYSTEM COMMISSIONING**

A. Do clock system commissioning in accordance with Section [27 10 53 - Clock System Commissioning].

### **3.09 PROTECTION**

A. Protect installed products and accessories from damage during construction.

B. Repair damage to adjacent materials caused by clock system installation.

**END OF SECTION 27 51 13**

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## 28 23 00 VIDEO SURVEILLANCE

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Cameras.
- B. Control equipment.
- C. Cable and accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Division 26 Electrical
- B. Division 27 Voice and Data

#### 1.3 REFERENCE STANDARDS

- A. CEC – California Electrical Code.

#### 1.4 SYSTEM DESCRIPTION

#### 1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements, including system wiring diagram.
- C. Product Data: Provide showing electrical characteristics and connection requirements for each component.
- 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, installation, and starting of product.
- E. Project Record Documents: Record actual locations of cameras and routing of television cable.
- F. Operation Data: Instructions for starting and operating system.
- G. Maintenance Data: Routine trouble shooting procedures.

#### 1.6 QUALITY ASSURANCE

- A. Conform to requirements of CEC.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified

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in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

- C. Supplier Qualifications: Authorized distributor of specified manufacturer Pelco with minimum three years documented experience.
- D. Installer Qualifications: Authorized installer of specified manufacturer with service facilities within 100 miles of Project.
- E. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and indicated.

## **PART 2 PRODUCTS**

### **2.1 COORDINATE ALL INSTALLATIONS WITH DJUSD IT DEPARTMENT.**

- A. Integrate camera locations with existing campus head end.
  - 1. Review and assess existing analog or digital camera systems. Any system components older than 7 years shall be replaced as part of the project.
  - 2. Review each camera location for proper lighting and modify/add lighting as required.
  - 3. Review existing and new landscape environment (trees, etc.) to allow the best possible unobstructed view from the camera. Designer shall consider the size of the trees in 10 years from planting.
  - 4. Main components of the CCTV system shall include, but not limited to:
  - 5. IP Gateway with Analytics and support for 16 cameras (3rd party)
  - 6. Network Video Recorder
  - 7. High definition outdoor rated 6MP min. panoramic camera w/ mounting hardware and accessories.
  - 8. High definition outdoor rated 4MP min. bullet camera w/ mounting hardware and accessories.
  - 9. High definition indoor rated 4MP min. dome camera w/ mounting hardware and accessories.
- B. System shall provide 7-days local video storage and 30-days hosted video storage.
- C. Contractor to provide 128GB SD cards with cameras if SD card required.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Use branch video cable for circuits less than 500 feet; use main video cable for circuits longer than 500 feet. Provide equalizing amplifier for circuits longer than 100 feet.

### **3.2 INTERFACE WITH OTHER PRODUCTS**

- A. Interface installation of video surveillance with security access and intrusion detection systems.

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### **3.3 FIELD QUALITY CONTROL**

- A. Provide the services of manufacturer's technical representative to prepare and start systems and supervise final wiring connections and system adjustments.

### **3.4 ADJUSTING**

- A. Adjust manual lens irises to meet lighting conditions.

### **3.5 CLOSEOUT ACTIVITIES**

- A. Demonstrate system operation and provide two hours of instruction with manufacturer's training personnel.
- B. Conduct walking tour of project and briefly describe function, operation, and maintenance of each component.

### **3.6 MAINTENANCE**

- A. See Section 017000 - Execution Requirements, for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.
- C. Provide service and maintenance of system for one year from Date of Substantial Completion.

**END OF SECTION 28 23 00**

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## SECTION 28 4600 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. Maintenance of fire alarm system under contract for specified warranty period.

#### 1.02 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping: Materials and methods for work to be performed by this installer.
- B. Section 21 1300 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.
- C. Section 23 3300 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

#### 1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Drawings must be prepared using AutoCAD Release 2018.
  - 1. Owner will provide floor plan drawings for Contractor's use; verify all dimensions on Owner-provided drawings.
- C. Evidence of designer qualifications.
- D. 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.
  - 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. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
  - 10. 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.
  - 11. Certification by Contractor that the system design complies with the contract documents.
- E. Evidence of installer qualifications.
- F. Evidence of instructor qualifications; training lesson plan outline.
- G. Evidence of maintenance contractor qualifications, if different from installer.
- H. 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.

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- I. Operating and Maintenance Data: See Section 01 7800 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.
- J. Project Record Documents: See Section 01 7800 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.
- K. 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.

#### **1.04 QUALITY ASSURANCE**

- A. 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.
- B. 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.
- C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
- D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

#### **1.05 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for 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.

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- 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: Gamewell-FCI (E3 Series).
- B. Initiating Devices and Notification Appliances:
1. Provide initiating devices and notification appliances made by the same manufacturer, where possible.

### **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 the 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, which is DSA.
    - c. Applicable local codes.
    - d. 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.
  7. Program notification zones and voice messages as directed by Owner.
  8. Fire Command Center: Location indicated on drawings.
  9. Fire Alarm Control Unit: New, located at Pool Restroom Building, IDF Room.
- B. Supervising Stations and Fire Department Connections:
1. Public Fire Department Notification: By remote supervising station.
  2. Remote Supervising Station: UL-listed central station under contract to facility.
  3. Means of Transmission to Remote Supervising Station: Digital alarm communicator transmitter (DACT), 2 telephone lines.
- 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. Signaling Line Circuits (SLC) Between Buildings: Class A, Style 2.
  4. Notification Appliance Circuits (NAC): Class B, Style W.
- D. 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.

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- 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.
- C. HVAC:
  - 1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.

## 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: Gamewell-FCI (E3 Series).
- D. Master Control Unit: Existing Main FACP located at Building "M" Elec. Room.
- E. Remote Annunciators: Replace existing located at building "A" Admin Office.
- F. Initiating Devices:
  - 1. Addressable Systems:
    - a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
    - 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: [ ].
  - 3. Smoke Detectors: [ ].
  - 4. Heat Detectors: [ ].
  - 5. Addressable Interface Devices: [ ].
- G. Notification Appliances:
  - 1. Speakers: [ ].
  - 2. Strobes: [ ].
- 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 the 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.

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### **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.

### **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.
- 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.
- D. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

### **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.

### **3.05 MAINTENANCE**

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. 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.
- C. Provide trouble call-back service upon notification by Owner:
  - 1. Provide on-site response within 2 hours of notification.

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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.
- D. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
  - E. 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.
  - F. Comply with Owner's requirements for access to facility and security.

**END OF SECTION 28 4600**

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## SECTION 31 1000 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 1000 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 1000 - Summary: Sequencing and staging requirements.
- C. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- D. Section 01 5713 - Temporary Erosion and Sediment Control.
- E. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.
- F. Section 01 7419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- G. Section 02 4100 - Demolition: Removal of built elements and utilities.
- H. Section 31 2323 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.
- I. Section 32 9300 - Plants: Relocation of existing trees, shrubs, and other plants.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. Fill Material: As specified in Section 31 2323 - Fill.

### PART 3 EXECUTION

#### 3.01 SITE CLEARING

- A. Comply with other requirements specified in Section 01 7000.
- B. 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 begin clearing until vegetation to be relocated has been removed.
- C. Preservation of existing vegetation: The construction schedule shall consider the amount and duration of soil exposed to erosion by wind, rainfall, and vehicle tracking and seek to minimize disturbed soil during the rainy season. A schedule shall be prepared that shows the sequencing of construction activities with installation of maintenance of soil stabilization and sediment control BMPs.

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- D. Do not remove or damage vegetation beyond the limits indicated on drawings.
  - 1. Exception: Specific trees and vegetation indicated on drawings to be removed.
  - 2. Exception: Selective thinning of undergrowth specified elsewhere.
- E. Install substantial, highly visible fences at least 3 feet (36 inches) feet high to prevent inadvertent damage to vegetation to remain:
  - 1. Around trees to remain within vegetation removal limits; locate no closer to tree than at the drip line.
  - 2. Around other vegetation to remain within vegetation removal limits.
  - 3. See Section 01 5000 for fence construction requirements.
- F. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.
- G. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
  - 1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
  - 2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 36 inches.
  - 3. Existing Stumps: Treat as specified for other vegetation removed; remove stumps and roots to depth of 36 inches.
  - 4. Fill holes left by removal of stumps and roots, using suitable fill material, with top surface neat in appearance and smooth enough not to constitute a hazard to pedestrians.
- H. Dead Wood: Remove all dead trees (standing or down), limbs, and dry brush on entire site; treat as specified for vegetation removed.
- I. 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 31 1000**

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## SECTION 31 2200 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 1000 - Site Clearing.
- B. Section 31 2316 - Excavation.
- C. Section 31 2316.13 - Trenching: Trenching and backfilling for utilities.
- D. Section 31 2323 - Fill: Filling and compaction.

#### 1.03 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

#### 1.04 QUALITY ASSURANCE

- A. Perform work in accordance with the Standards Specifications for Public Works Construction (Greenbook); current edition.
- B. Perform work in accordance with Project's Geotechnical Report.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. Topsoil: See Section 31 2323.
- B. Other Fill Materials: See Section 31 2323.

### 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. Protect from damage above- and below-grade utilities to remain.
- D. Provide temporary means and methods to remove all standing or ponding water from areas prior to grading.
- E. 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.
- F. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.
- G. 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.

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1. Remove sod, grass, and any other vegetation before stripping top soil.
  2. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
  3. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
  4. Strip topsoil to depth indicated on drawings.
- 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. See Section 31 2323 for filling procedures.
  - G. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.
  - H. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.
  - I. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack surface water control.

#### **3.04 SOIL REMOVAL**

- A. Stockpile topsoil to be re-used on site; remove remainder from site.
  1. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water and other erosion control measures.
    - a. Limit height of topsoil stockpiles to 72 inches.
    - b. Do not stockpile topsoil within plant protection zones.
    - c. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or resued.
- B. Stockpile subsoil to be re-used on site; remove remainder from site.

#### **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 2 inch in size. Remove soil contaminated with petroleum products.
- C. Where topsoil is to be placed, scarify surface to depth of 6 inches.
- D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 12 inches.
- E. Place topsoil in areas indicated.
- 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.

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### **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. Trees to Remain: If damaged due to this work, trim broken branches and repair bark wounds; if root damage has occurred, obtain instructions from Architect as to remedy.
- C. 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 2323 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 31 2200**

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## SECTION 31 2316.13 TRENCHING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Backfilling and compacting for utilities outside the building.

#### 1.02 RELATED REQUIREMENTS

- A. Document "Geotechnical Engineering and Geologic Hazards Investigation, Davis Senior High School Aquatics Project" prepared by WallaceKuhl, Project No. 13012.01P: Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 31 2200 - Grading: Site grading.
- C. Section 31 2316 - Excavation: Building and foundation excavating.
- D. Section 31 2323 - Fill: Backfilling at building and foundations.

#### 1.03 DEFINITIONS

- A. Finish Grade (FG) Elevations: Indicated on drawings.
- B. Finish Surface (FS) Elevations: Indicated on drawings.
- C. Subgrade Elevations: Indicated on drawings.

#### 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.
- B. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- D. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
- E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
- F. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
- G. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- H. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- I. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- J. Standard Specifications for Public Works Construction (Greenbook); current edition.

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Samples: 10 pound sample of each type of fill; submit in air-tight containers to testing laboratory.
- C. Materials Sources: Submit name of imported materials source.
- D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- E. Compaction Density Test Reports.

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## **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 allowed by owner.
  - 1. Protect stockpiles from erosion and deterioration of materials.

## **PART 2 PRODUCTS**

### **2.01 FILL MATERIALS**

- A. General Fill: Subsoil excavated on-site.
  - 1. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
- B. Engineered Fill: Conforming to Greenbook Section 200-1.4, and recommendations as stated in the Project's Geotechnical Report.
- C. Concrete for Fill: Lean concrete conforming to Greenbook Section 200-4, and recommendations as stated in the Project's Geotechnical Report.
- D. Granular Fill: Crushed rock, conforming to Greenbook Section 200-1.2, and recommendations as stated in the Project's Geotechnical Report. Gravel use is acceptable only when used in conjunction with filter fabric.
- E. Sand: Conforming to Greenbook Section 200-1.5, and recommendations as stated in the Project's Geotechnical Report.

### **2.02 ACCESSORIES**

- A. Geotextile Fabric: Non-biodegradable, woven Mirafi ; 140N manufactured by Mirafi.
- B. Detectable Warning Tape: Install detectable warning tape during the installation of proposed utilities on contract drawings. Acid- and alkali-resistant, polyethylene film warning tape manufactured for making and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 5 mils (0.1mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep, colored as follows:
  - 1. Red: Electric and cathodic protection.
  - 2. Yellow: Gas, oil, steam, and dangerous materials.
  - 3. Orange: Telephone, fiber optic, and other communications.
  - 4. Blue: Potable water and fire protection service systems.
  - 5. Green: Sewer and storm drainage systems.
  - 6. Purple: Non-potable reclaimed water.

### **2.03 SOURCE QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, testing of samples for compliance will be provided 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. 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. Locate, identify, and protect utilities that remain and protect from damage.
- C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

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- D. Protect plants, lawns, rock outcroppings, and other features to remain.
- E. 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 large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- G. Remove excavated material that is unsuitable for re-use from site.
- H. Stockpile excavated material to be re-used in area designated in Section 31 2200.
- I. Remove excess excavated material from site.
- J. 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.
- K. 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 to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
- 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. Correct areas that are over-excavated.
  - 1. Thrust bearing surfaces: Fill with concrete.
  - 2. Other areas: Use general fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.
- G. Compaction Density Unless Otherwise Specified or Indicated:
  - 1. Under paving, slabs-on-grade, and similar construction: 95 percent of maximum dry density.
  - 2. At Landscaped areas: 90 percent of maximum dry density.
- H. 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.

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- B. Utility Piping and Conduits:
  - 1. Bedding: Use clean sands in accordance with Greenbook requirements to a depth of at least 1 foot over the pipe.
  - 2. Cover with general fill.
  - 3. Fill up to subgrade elevation.
  - 4. Compact in maximum 8 inch lifts to 95 percent of maximum dry density.
- C. Over Subdrainage Piping at Foundation Perimeter and Under Slabs:
  - 1. Drainage fill and geotextile fabric: Section 33 4100.
  - 2. Cover drainage fill with general fill.
  - 3. Fill up to subgrade elevation.
  - 4. Compact to 95 percent of maximum dry density.

### **3.07 TOLERANCES**

- A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.
- B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

### **3.08 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.
- 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.
- E. Frequency of Tests: As required by the Geotechnical Engineer.

### **3.09 CLEANING**

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

**END OF SECTION 31 2316.13**

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## SECTION 31 2316 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.

#### 1.02 RELATED REQUIREMENTS

- A. Document "Geotechnical Engineering and Geologic Hazards Investigation, Davis Senior High School Aquatics Project" prepared by WallaceKuhl, Project No. 13012.01P: Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 01 5713 - Temporary Erosion and Sediment Control: Slope protection and erosion control.
- C. Section 01 7000 - Execution and Closeout Requirements: 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.
- D. Section 31 2200 - Grading: Grading.
- E. Section 31 2316.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.
- F. Section 31 2323 - Fill: Fill materials, backfilling, and compacting.

### PART 2 PRODUCTS

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the work are as indicated.

#### 3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect from damage.
- C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- D. Protect plants, lawns, rock outcroppings, and other features to remain.
- E. 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 EXCAVATING

- A. Excavate to accommodate new structures and construction operations.
- B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. 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.

#### 3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.

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- B. Provide for visual inspection of load-bearing excavated surfaces by Architect before placement of foundations.

### **3.05 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 31 2316**

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## SECTION 31 2323 FILL

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Filling, backfilling, and compacting for building volume below grade, slabs-on-grade, paving, and site structures.
- 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.

#### 1.02 RELATED REQUIREMENTS

- A. Document "Geotechnical Engineering and Geologic Hazards Investigation, Davis Senior High School Aquatics Project" prepared by WallaceKuhl, Project No. 13012.01P: Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 01 5713 - Temporary Erosion and Sediment Control: Slope protection and erosion control.
- C. Section 31 2200 - Grading: Site grading.
- D. Section 31 2316 - Excavation: Removal and handling of soil to be re-used.
- E. Section 31 2316.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.

#### 1.03 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: Indicated on drawings.

#### 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.
- B. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- D. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
- E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
- F. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- G. Standard Specifications for Public Works Construction (Greenbook); current edition.

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - 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.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. When fill materials need to be stored on site, locate stockpiles where designated.
  - 1. Protect stockpiles from erosion and deterioration of materials.

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## **PART 2 PRODUCTS**

### **2.01 FILL MATERIALS**

- A. General Fill: Subsoil excavated on-site.
  - 1. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
- B. Engineered Fill: Conforming to Greenbook Section 200-1.4, and recommendations as stated in the Project's Geotechnical Report.
- C. Concrete for Fill: Lean concrete conforming to Greenbook Section 200-4, and recommendations as stated in the Project's Geotechnical Report.
- D. Granular Fill: Crushed rock, conforming to Greenbook Section 200-1.2, and recommendations as stated in the Project's Geotechnical Report. Gravel use is acceptable only when used in conjunction with filter fabric.
- E. Sand: Conforming to Greenbook Section 200-1.5, and recommendations as stated in the Project's Geotechnical Report.

### **2.02 ACCESSORIES**

- A. Geotextile Fabric: Non-biodegradable, woven Mirafi ; 140N manufactured by Mirafi.

### **2.03 SOURCE QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, testing of samples for compliance will be provided 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. Verify that survey bench marks and intended elevations for the Work are as indicated.
- B. Identify required lines, levels, contours, and datum locations.
- C. See Section 31 2200 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 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 to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
- 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.

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- F. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- G. Correct areas that are over-excavated.
  - 1. Load-bearing foundation surfaces: Use structural fill, flush to required elevation, compacted to 100 percent of maximum dry density.
  - 2. Other areas: Use general fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.
- H. Compaction Density Unless Otherwise Specified or Indicated:
  - 1. Under paving, slabs-on-grade, and similar construction: 95 percent of maximum dry density.
  - 2. At Landscaped areas: 90 percent of maximum dry density.
- I. Reshape and re-compact fills subjected to vehicular traffic.
- J. 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 FILL AT SPECIFIC LOCATIONS**

- A. Over Subdrainage Piping at Foundation Perimeter and Under Slabs:
  - 1. Refer to Section 312316.13.
- B. Over Buried Utility Piping and Conduits
  - 1. Refer to Section 312316.13.

### **3.05 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.

### **3.06 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor").
- C. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- D. Frequency of Tests: As required by the Geotechnical Engineer.
- E. Proof roll compacted fill at surfaces that will be under slabs-on-grade.

### **3.07 CLEANING**

- A. See Section 01 7419 - 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 31 2323**

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## SECTION 32 0190 LANDSCAPE MAINTENANCE

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. Furnish all labor, material, equipment and services required to maintain landscape in a healthy growing condition and in a neat and attractive appearance throughout the maintenance period.

#### 1.02 RELATED REQUIREMENTS

- A. Division 32 Section Landscape Irrigation
- B. Division 32 Section Landscape Work

#### 1.03 QUALITY ASSURANCE

- A. The Maintenance Contractor shall be experienced in horticulture and landscape maintenance, practices and techniques, and shall provide sufficient number of workers with adequate equipment to perform the work during the maintenance period.

#### 1.04 MAINTENANCE PERIOD

- A. Continuously maintain the entire project area during the progress of the work and during the ninety (90) calendar-day maintenance period until final acceptance of the project by the Landscape Architect,
  - 1. Maintenance Period begins following "Final Completion" of the Project and after all punchlist or corrective items have been accepted by the Landscape Architect and owner.
- B. Maintenance period shall not start until final completion, when all elements of construction, planting and irrigation for the entire project are in accordance with Plans and Specifications. A prime requirement is that all lawn and landscape areas shall be planted and that all lawn areas shall show an even, healthy stand of grass seedlings which shall have been mown twice. If such criteria are met to the satisfaction of the Landscape Architect, a written notification shall be issued to establish the effective beginning date of maintenance period.
- C. Any day of improper maintenance, as determined by the Landscape Architect, shall not be credited as an acceptable maintenance period day. The maintenance period shall be extended on a daily basis if the work is not in accordance to the Plans and Specifications. Project shall not be segmented into maintenance areas or phases, unless authorization of the Landscape Architect is obtained.
- D. Maintenance shall continue beyond the ninety (90) day maintenance period, as required, until final acceptance is given by the Landscape Architect.
- E. Contractor shall provide protection to the project site during the maintenance period.
- F. A phased maintenance period will not be accepted.

#### 1.05 GUARANTEE AND REPLACEMENT

- A. Guarantee: All plant material and other materials installed under the Contract shall be guaranteed against any and all poor, inadequate or inferior materials and/or workmanship or improper maintenance, as determined by the Landscape Architect, and shall be replaced by the Contractor at his expense. Warranty periods are as follows:
  - 1. Trees, vines, and shrubs: One Year
  - 2. Groundcover and Turf: One year.
- B. Replacement: Any materials found to be dead, missing, declining or not in a satisfactory or healthy condition during the maintenance period shall be replaced immediately. The Landscape Architect shall be sole judge as to the condition of material. Material to be replaced within the guarantee period shall be replaced by the Contractor within five (5) days of written notification by the Landscape Architect or owner. All replacement materials and installations shall comply with the Plans and Specifications. Any plant missing due to suspected theft shall be replaced by the Contractor. If the Contractor suspects that theft may be a problem, the Contractor shall provide written documentation to the owner that security on this site needs to be intensified.

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- C. The Contractor may relieve himself of theft responsibility if after the security notice, with no result, a written notice to the owner shall be given that plant material will not be replaced for theft or vandalism due to lack of site security being maintained. This procedure may take place only during the Landscape Maintenance Period.

#### **1.06 OBSERVATION SCHEDULE**

- A. Normal progress observations shall be requested by the Contractor from the Landscape Architect as per observations listed in specifications Division 32 Section "Landscape Work."

#### **1.07 FINAL ACCEPTANCE OF THE PROJECT**

- A. Upon completion of all project work, including maintenance period, the Landscape Architect will, upon proper written request, make an observation to determine final project acceptability. Provide minimum a 14 business day notice for final observation.
- B. Where observed work does not comply with the Plans and Specifications, replace rejected work and continue specified maintenance period until reinspected by the Landscape Architect and determined to be acceptable. All replacement materials and installations shall be in accordance with the Plans and Specifications. Remove rejected work and materials immediately from project. Prior to the date of final observation, Contractor shall provide the Landscape Architect with all Record Drawings and close out documents in accordance with the Plans and Specifications.

### **PART 2 - PRODUCTS**

#### **2.01 MATERIALS**

- A. All materials used shall either conform to Specifications in other sections or shall otherwise be acceptable to the Landscape Architect. The Landscape Architect shall be given a monthly record of all herbicides, insecticides and disease control chemicals used and irrigation scheduled. The amendments listed herein are for Bidding purposes only. The final amendment types and rates shall be determined by the Agronomic Soils Test.
- B. Turf maintenance fertilizer: shall be "Best Turf Supreme 16-6-8":
  - 1. 16% nitrogen
  - 2. 6% phosphoric acid
  - 3. 8% potash
- C. Slow Release maintenance fertilizer: shall be "Best Superturf 25-5-5 with Polyon" and shall consist of the following percents by weight:
  - 1. 25% nitrogen
  - 2. 5% phosphoric acid
  - 3. 5% potash

### **PART 3 - EXECUTION**

#### **3.01 GENERAL MAINTENANCE**

- A. General: Proper maintenance, including watering, weeding, mowing, edging, fertilization, rolling of turf, replacement and infill of mulch replacement of jute mesh, infill of settled areas, repairing and protection shall be required until entire project is finally accepted, but in any event for a period of not less than the specified maintenance period after planting.
- B. Watering: Thoroughly water to insure vigorous and healthy growth until work is accepted. Water in a manner to prevent erosion due to application of excessive quantities of water. When hand watering use a water wand to break the water force. Supplemental hand water as required to maintain and encourage the proper growth of new and existing plant material.
- C. Weeding:
  - 1. Keep plant basins, turf areas and areas between plants free of weeds. Control weeds with pre-emergent herbicides. If weeds develop, use legally approved herbicides and hand remove. Avoid frequent soil cultivation that destroys shallow roots. Weeding also shall be included in all paved areas including public or private sidewalks.

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2. Hand weed as required in addition to the application of weed control herbicides and pre-emergent to maintain all areas free of weeds including turf species other than the specified species. Periodic or predetermined weeding schedules may not be adequate and should be supplemented.
  3. Apply a final application of pre-emergent herbicide at the end of the maintenance period, just prior to final acceptance.
- D. Tree basins in turf areas: Remove turf from around each tree to create a 4'- 0" diameter basin depending on tree size.
- E. Pruning
1. Trees: Prune trees to select and develop permanent scaffold branches; to eliminate narrow V-shaped branch forks that lack strength; to reduce toppling and wind damage by thinning out crowns; to maintain a natural appearance and to balance crown with roots. All trees shall be maintained and pruned in accordance with the accepted practices of the American Society of Consulting Arborists (ASCA). Prune only as directed by the Registered Consulting Arborists and Landscape Architect.
  2. Shrubs: Same objectives as for trees. Shrubs shall not be clipped into balled or boxed forms unless such is required by the landscape plans. All pruning cuts shall be made to lateral branches, buds or flush with the trunk. Stubbing and heading shall not be permitted.
  3. Only skilled workers shall perform pruning work in accordance with standard horticultural pruning practices. Remove from the project all pruned branches and material. Remove and replace any plant material excessively pruned or malformed resulting from improper pruning practices at no additional costs to the owner.
  4. Improperly pruned plant material as determined by the Landscape Architect is to be replaced at no cost to the owner.
- F. Staking and Guys: Stakes and guys shall remain in place through the guarantee period and shall be inspected and adjusted to prevent rubbing that causes bark wounds. Remove nursery stake from all trees that are staked with lodgepole stakes per specifications. Provide supplemental staking or guying as required during high wind events to prevent damage to trees. Any damaged tree caused by high winds must be replaced by the contractor at no cost to the owner.
- G. Insect, Animal, Rodent and Disease Control: Maintain proper control with legally approved materials as required as part of the Contract.
- H. Protection: The Contractor shall maintain protection of the planted areas. Damaged areas shall be repaired or replaced at the Contractor's expense.
- I. Trash: Remove trash weekly in all planted areas, pedestrian walkways and parking areas. Maintain all areas free of trash, clippings, and debris at all times.
- J. Replacement: As per Guarantee and Replacement Specifications of this Section.
- K. Fertilization: Fertilize all planting areas, during and just prior to end of maintenance period with the slow release maintenance fertilizer as indicated in the agronomic soils report.
- L. Watering: Planting areas shall be watered at such frequency as weather conditions require to replenish soil moisture below root zone and to establish healthy plant material.
1. Contractor is responsible for water audits and payment of any local penalties by local water districts at no additional cost to the Owner.

### **3.02 LAWN AND TURF MAINTENANCE**

- A. Mowing and Edging

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1. Initial mowing of turf will commence when the grass has reached a height of two and one-half (2-1/2) inches. The height of cut will be two (2) inches. After initial establishment maintain Bermuda and creeping grasses at 1½" and fescues or rye grass at 2". Mowing will be at least every 4-6 days for the second through fifth cuttings, and at least once per week after that for fescue. Bermuda grass is to be mowed minimum twice a week. Bent grass is to be mowed daily. Turf must be well established and free of bare spots and weeds to the satisfaction of the Landscape Architect prior to final acceptance.
  2. Excess grass clippings shall be picked up and removed from the site and premises. Let turf areas dry out enough so that mower wheels do not skid, tear or mark the lawn. Edges shall be trimmed at 90 degrees to pavement, at least weekly or as needed for neat appearance. Clippings shall be removed from paved and planting areas, etc. and disposed of from the site.
- B. Watering: Lawns shall be watered at such frequency as weather conditions require to replenish soil moisture below root zone and to establish healthy strands of grass.
1. Contractor is responsible for water audits and payment of any local penalties by local water districts at no additional cost to the Owner.
- C. Disease control: Control turf diseases throughout the maintenance period with legally approved fungicides and herbicides. Replace any damaged or infected grass.
- D. Weed Control:
1. Control broad leaf weeds with selective, legally approved herbicides throughout maintenance period.
  2. A final application of selective herbicide shall be applied at the end of the landscape maintenance period, acceptance, just prior to final acceptance.
  3. Hand weed as required in addition to the application of weed control herbicides and pre-emergent to maintain all areas free of weeds including turf species other than the specified species. Periodic or predetermined weeding schedules may not be adequate and should be supplemented.
- E. Fertilization:
1. During maintenance period an application of turf maintenance fertilizer, as specified, shall be made at thirty (30) day intervals from the date of maintenance period start at a rate of five (5) pounds per 1,000 square feet, and as required by the agronomic soils report.
  2. Final application (just prior to final acceptance) shall be made with the slow-release maintenance fertilizer as required by the agronomic soils report.
  3. Replacement: At conclusion of maintenance period a final observation of lawn and turf areas shall be made. Remove diseased areas and unhealthy strands of grass from the site; do not bury into the soil. Replant areas with material and in a manner as specified on the Plans and Specifications at no additional cost to the Owner. All grass is to be fully grown with 100% coverage with a suitable thatch layer prior to turnover and final acceptance.
- F. Arborist: Provide a written report and recommendations as required by the landscape architect if any plant material is in the sole opinion of the landscape architect, declining, stressed, infested, or otherwise not growing at the anticipated growth rate. The report is to include Agronomic Soils Test Data and recommendations and be provided at no cost to the owner.

### 3.03 IRRIGATION SYSTEM

- A. System Observation: The Contractor shall check all systems for proper operation. Lateral lines shall be flushed out after removing the last sprinkler head or two at each end of the lateral. All heads are to be adjusted as necessary for unimpeded head to head coverage.
- B. Valves: Contractor shall set, and verify that all pressure regulating valves to the operating pressure specified on the drawings.
- C. Controllers: Set and program automatic controllers for seasonal water requirements. Give the Owner's Representative instructions on how to turn off system in case of emergency.

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- D. If the irrigation system is designed and specified to be operable from a central irrigation computer controller located off site, or a standard controller on site. The contractor shall demonstrate to Landscape Architect, Owner's Representative and future maintenance contractor that the central irrigation system is fully installed and operational from this off site control system as described and specified. Contractor shall make all adjustments as necessary to insure this operation prior to final acceptance.
- E. Contractor shall set up and coordinate training for the Maintenance Contractor (Provider) on the irrigation controller, and pump with the manufactures representative. Maintenance period shall not end, and the project will not be accepted until this training has been completed.
- F. Repairs: Repair all damages to irrigation system at the Contractor's expense. Repairs shall be made within twenty-four (24) hours or sooner to prevent damage to site improvements.

#### **3.04 CLEANING**

- A. During maintenance work, keep pavements clean and work area in an orderly condition. Haul away and remove all debris from landscape areas, and do not leave any clippings, fertilizer, amendments and / or other material from landscape planting and/or maintenance period.
- B. Powerwash all pavement and flatwork as necessary to remove all staining and tire marks on surfaces caused by maintenance or construction vehicles, prior to final acceptance.

**END OF SECTION 32 0190**

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## SECTION 32 1123 AGGREGATE BASE COURSES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Aggregate base course.

#### 1.02 RELATED REQUIREMENTS

- A. Section 31 2200 - Grading: Preparation of site for base course.
- B. Section 31 2316.13 - Trenching: Compacted fill over utility trenches under base course.
- C. Section 31 2323 - Fill: Compacted fill under base course.
- D. Section 32 1216 - Asphalt Paving: Finish and binder asphalt courses.
- E. Section 32 1313 - Concrete Paving: Finish concrete surface course.

#### 1.03 REFERENCE STANDARDS

- A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base, and Surface Courses.
- 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.
- C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- D. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- E. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
- F. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
- G. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
- H. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- I. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- J. Standard Specifications for Public Works Construction (Greenbook); current edition.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Materials Sources: Submit name of imported materials source.
- C. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- D. Compaction Density Test Reports.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. 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

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- A. Aggregate Base [<>]: Crushed aggregate base, conforming to Greenbook, Section 200-2.2.
- B. Herbicide: Commercial chemical for weed control, registered by the EPA.

## **2.02 SOURCE QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of aggregate materials.
- B. Where aggregate materials are specified using ASTM D2487 classification, testing of samples for compliance will be provided 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. 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. Spread aggregate over prepared substrate to a total compacted thickness as indicated on plans.
- B. Place aggregate in maximum 4 inch layers and roller compact to specified density.
- C. Level and contour surfaces to elevations and gradients indicated.
- D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- E. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- G. Apply herbicide per manufacturer requirements.

### **3.04 TOLERANCES**

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch.
- C. Variation From Design Elevation: Within 1/2 inch.

### **3.05 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Compaction density testing will be performed on compacted aggregate base course in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.
- C. 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").
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Proof roll compacted aggregate at surfaces that will be under slabs-on-grade.

### **3.06 CLEANING**

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- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

**END OF SECTION 32 1123**

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## **SECTION 32 1216 ASPHALT PAVING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Single course bituminous concrete paving.
- B. Double course bituminous concrete paving.
- C. Surface sealer.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 31 2200 - Grading: Preparation of site for paving and base.
- B. Section 31 2323 - Fill: Compacted subgrade for paving.
- C. Section 32 1123 - Aggregate Base Courses: Aggregate base course.
- D. Section 32 1313 - Concrete Paving: Concrete curbs.
- E. Section 321723.13 - Painted Pavement Markings

#### **1.03 REFERENCE STANDARDS**

- A. AI MS-2 - Asphalt Mix Design Methods.
- B. AI MS-19 - Basic Asphalt Emulsion Manual.
- C. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
- D. Standard Specifications for Public Works Construction (Greenbook); current edition.

#### **1.04 QUALITY ASSURANCE**

- A. Perform Work in accordance with the latest Greenbook specifications.
- B. Mixing Plant: Conform to [\_\_\_\_\_].
- C. Obtain materials from same source throughout.

#### **1.05 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

#### **1.06 FIELD CONDITIONS**

- A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.
- B. Place bitumen mixture when temperature is not more than 15 F degrees below bitumen supplier's bill of lading and not more than maximum specified temperature.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. Asphalt Concrete: Greenbook, Section 203-6.
- B. Aggregate Base Course: Section 321123.
- C. Tack Coat: Emulsified asphalt.
- D. Seal Coat: per Greenbook, Section 203-9

#### **2.02 ASPHALT PAVING MIXES AND MIX DESIGN**

- A. Base Course: B-PG 64-10-RAP per Greenbook Table 203-6.4.3 (A).
- B. Wearing Course: D2-PG 64-10-RAP per Greenbook Table 203-6.4.3 (A).
- C. Provide mixes complying with composition, grading, and tolerance requirements in ASTM D 3515 for the following nominal, maximum aggregate sizes:

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1. Base Course: 1 inch.
2. Surface Course: 1/2 inch.
3. Surface Course for Playgrounds and Similar Areas: 1/4 inch.

D. Submit proposed mix design of each class of mix for review prior to beginning of work.

### **2.03 SOURCE QUALITY CONTROL**

- A. Test mix design and samples in accordance with [\_\_\_\_\_].

## **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. See Section 32 1123.

### **3.03 PREPARATION - TACK COAT**

- A. Apply tack coat in accordance with Greenbook, Section 302-5.4.
- B. Apply tack coat to contact surfaces of curbs, gutters and adjacent pavement to remain.

### **3.04 PLACING ASPHALT PAVEMENT - SINGLE COURSE**

- A. Install Work in accordance with the Greenbook standard specifications.
- B. Place asphalt within 24 hours of applying primer or tack coat.
- C. Place to a maximum thickness of 4 inches.
- D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- E. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

### **3.05 PLACING ASPHALT PAVEMENT - DOUBLE COURSE**

- A. Place asphalt base course within 24 hours of applying primer or tack coat.
- B. No pavement course shall be less than 1 1/2 inches in compacted thickness. If finish pavement thickness is 3 inches or less it shall be laid as single course.
- C. No pavement course shall be more than 4 inches in compacted thickness.
- D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- E. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

### **3.06 SEAL COAT**

- A. Apply seal coat to surface course and asphalt curbs in accordance with the Greenbook standard specifications.

### **3.07 TOLERANCES**

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness.
- C. Variation from True Elevation: Within [\_\_\_\_\_] inch.

### **3.08 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for quality control.
- B. Provide field inspection and testing. Take samples and perform tests in accordance with the Geotechnical Engineer's requirements.

### **3.09 PROTECTION**

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- A. Immediately after placement, protect pavement from mechanical injury for no less than 48 hours days or until surface temperature is less than 140 degrees F.

**END OF SECTION 32 1216**

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## SECTION 32 1313 CONCRETE PAVING

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. Driveways.
- B. Roadways.
- C. Parking lots.
- D. Curbs and gutters.
- E. Walks.
- F. Stairs and ramps.
- G. Mow strips.
- H. Wheel stops.
- I. Pavement marking paint.
- J. Detectable warnings.

#### 1.02 RELATED REQUIREMENTS

- A. Division 03 Section Cast-in-Place Concrete
- B. Division 05 Section Metal Fabrications
- C. Division 05 Section Pipe and Tube Railings.
- D. Division 31 Section Earthwork
- E. Division 32 Section Architectural Site Concrete
- F. Division 32 Section Concrete Paving Joint Sealants
- G. Division 32 Section Chain Link Fences and Gates
- H. Division 32 Section Decorative Metal Fences and Gates

#### 1.03 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: Fly ash and other pozzolans, and ground granulated blast-furnace slag, subject to compliance with requirements.

#### 1.04 PREINSTALLATION CONFERENCE

- A. Conduct conference at Project site two weeks prior to start of work of this section. Required attendance of all affected installers.
  - 1. Review methods and procedures related to concrete paving, including but not limited to, the following:
  - 2. Concrete mixture design
  - 3. Testing and inspection procedures.
  - 4. Concrete finishes and finishing.
  - 5. Cold- and hot-weather concreting procedures.
  - 6. Curing procedures.
  - 7. Construction joints.
  - 8. Forms and form-removal limitations.
  - 9. Reinforcement accessory installation.
  - 10. Concrete repair procedures.
  - 11. Protection of cast-in-place architectural site concrete.
  - 12. Review special testing and inspection procedures.
  - 13. Placement sequence and schedule.

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14. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
  - a. Contractor's superintendent.
  - b. Independent testing agency responsible for concrete design mixtures.
  - c. Ready-mix concrete manufacturer.
  - d. Concrete paving subcontractor.
  - e. District's Representative
  - f. Architect's Representative
  - g. Inspector of Record
  - h. Manufacturer's representative for specialty concrete paving finishes.
  - i. Provide meeting minutes for pre-installation conference

#### 1.05 SUBMITTALS

- A. Product Data: For each type of product indicated.
  1. Proprietary admixtures, pigments, curing compounds, hardeners, sealers, form-release agents, etc.: Indicate compatibility with other materials used.
  2. Stenciling material
- B. Samples for Initial Selection: For each type of product, finish, ingredient, or admixture requiring color selection.
  1. Submit full range of manufacturer's standard and custom range of colors and products for review and selection. Provide custom colors on samples as required. Upon selection of color, submit 12"x12" sample of material in the specified color finish for review by Landscape Architect in addition to the specified mock ups.
  2. Stencil Shop Drawing submittal to Architect for approval is required before mock up work for stenciling is to begin.
  3. Wheel Stops: 6 - 7 inches wide in cross section; with fasteners.
  4. Preformed Traffic-Calming Devices: 6 inches long showing cross section; with fasteners.
- C. Design Mixtures: Submit proposed mix designs and test data for each class of concrete and for each method of placement.
  1. Prepare mix designs on the basis of field experience (preferred) and/or trial mixes, in compliance with California Building Code (CBC), Section 1905A.3.
  2. Prepare mix designs on the basis of field experience (preferred) and/or trial mixes, in compliance with California Building Code (CBC), Section 1905.3.
  3. Mix designs shall be prepared, stamped and signed by a structural or civil engineer registered in the State of California.
    - a. Mix designs shall be reviewed by the Architect (AOR) and Structural Engineer of Record (SEOR).
  4. Identify for each mix design submitted the method by which proportions have been selected.
    - a. For mix designs based on field experience, include individual strength test results, standard deviation, and required average compressive strength f'c calculations.
    - b. For mix designs based on trial mixtures, include trial mix proportions, test results, graphical analysis and show required average compressive strength f'c results. Provide gross weight and yield per cubic yard of trial mixes.
    - c. Indicate quantity of each ingredient per cubic yard of concrete and percentages.
    - d. Indicate type and quantity of admixtures proposed or required.
    - e. Indicate water to cement ratio by weight.
    - f. Measured slump.
    - g. Measured air content.
    - h. Provide shrinkage test results.
  5. Multiple mix designs or multiple manufacturers shall not be permitted for the same application.

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- D. Provide maximum 5% fly ash; ground granulated blast-furnace slag, and/or silica fume content as Portland cement replacement in all concrete.
- E. Mix designs should contain no fly ash.
- F. Submit proposed alternate design mixtures for review by the Architect and SEOR when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- G. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Shop drawings should include details such as reveals, recessed lights, handrails, or other elements requiring steel coordination.
  - 1. Coordinate with and identify the details of the Contract Drawings on the shop drawings.
  - 2. Comply with ACI 315, part B and CRSI requirements.
- H. Construction Joint Layout: Indicate proposed construction joints required to construct the structure. Submit dimensioned drawing indicating layout of construction joints, contraction (control) joints, dowelled joints, decorative scoring and placement sequence of concrete if different than layout indicated on plans.
  - 1. Location of construction joints are subject to approval of the Architect.
  - 2. All form seams are to align with construction joints or reveals.
- I. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.
- J. Pavement-Marking Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- K. Qualification Data: For qualified ready-mix concrete manufacturer (batch plant) and installer of detectable warnings.
- L. Welding Certificates: Submit certifications signed by AWS Certified Welding Inspector of prequalified welding procedures, qualifications of welding procedures unless prequalified, qualifications of welding operators and qualifications of welders.
- M. Material Certificates: For the following, submit manufacturer data, test results, and technical information for aggregate, sand and cement, submit ½ cubic foot physical sample. For sealant submit manufacturer color standard and custom palette together with physical samples:
  - 1. Cementitious materials.
  - 2. Aggregates and sand.
  - 3. Steel reinforcement and reinforcement accessories.
  - 4. Fiber reinforcement.
  - 5. Admixtures.
  - 6. Curing compounds.
  - 7. Applied finish materials.
  - 8. Bonding agent and epoxy adhesives.
  - 9. Joint fillers.
  - 10. Sealer
  - 11. Sealant.
  - 12. Pigments.
- N. 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.
- O. Detectable Warning Device Warranty: Submit copies of manufacture's five year warranty for each of these products and manufacturer custom and standard color palette.

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- P. Field quality-control reports.
  - 1. Submit copies of delivery tickets complying with ASTM C 94 for each load of concrete delivered to the site. Tickets shall include all information required by the referenced standard.
- Q. Minutes of pre-installation conference.

## 1.06 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with CBC Chapter 19A.
  - 1. Chemical products field-applied to concrete shall comply with the air quality requirements of authorities having jurisdiction.
  - 2. Comply with requirements of local, State and other authorities having jurisdiction for work performed within public right-of ways.
- B. Regulatory Requirements: Comply with CBC Chapter 19.
- C. Chemical products field-applied to concrete shall comply with the air quality requirements of authorities having jurisdiction.
- D. Comply with requirements of local, State and other authorities having jurisdiction for work performed within public right-of ways.
- E. Industry Standards: Comply with the following unless modified by requirements in the Contract Documents.
  - 1. ACI 301, "Specifications for Structural Concrete".
  - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials".
  - 3. ACI 302.1R, "Guide for Concrete Floor and Slab Construction".
  - 4. ACI 304R, "Guide for Measuring, Mixing, Transporting, and Placing Concrete".
  - 5. ACI 305R, "Hot Weather Concreting".
  - 6. ACI 306.1, "Standard Specification for Cold Weather Concreting".
  - 7. ACI 318, "Building Code Requirements for Structural Concrete".
  - 8. ACI 347, "Guide to Formwork for Concrete".
  - 9. ACI SP-66, "ACI Detailing Manual".
  - 10. CRSI, "Manual of Standard Practice".
  - 11. CRSI, "Placing Reinforcing Bars".
- F. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of cast-in-place, surface-applied unit-paver-type detectable truncated dome products.
- G. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M 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").
- H. Source Limitations for Concrete Paving: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties. Secure all material required for the duration of the project as needed to ensure consistent quality in appearance.
- I. Welding Qualifications: Comply with CBC Chapter 17A.
  - 1. Qualify welding procedures and welding personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel" prior to performing any welding.
  - 2. Qualify welding inspection personnel according to AWS QC1, "Standard for AWS Certification of Welding Inspectors."
- J. 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.

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- K. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.
- L. ACI Publications: Comply with ACI 301 unless otherwise indicated.
- M. Mockups: Before casting concrete paving, build mockups to verify selections made under Sample submittals and to fully demonstrate typical joints (including expansion and saw cut joints), surface finish, texture, color tolerances, standard of workmanship and completed product. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
  - 1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
    - a. Paving Modules: Construct at least one 4 ft. x 4 ft. mockup of each color, finish, and mix design of special paving module, including stenciled areas, banding and curbs
    - b. Radial Paving Patterns: Construct at least one 180 sq. ft. mockup of curved or radial paving patterns.
    - c. Abrasive-Blast Finishes: Mockups shall clearly demonstrate 3 levels of depth of cut for abrasive-blast finishes for Architect's review.
    - d. Stairs: Construct minimum 2 risers and treads X 4' long with nosing grooves and stained color within grooves for each color and finish specified.
    - e. Mow Strip: minimum 6' long for each specified width and color.
    - f. Stenciled Letters or Graphics: minimum 4 letters and one full size graphic for each size, font setting and finish. Mock up to be set on concrete pavement or wall matching conditions of final install.
    - g. Truncated Domes: minimum 3'X6' long set in concrete with concrete base and grout.
    - h. Repairs: In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes, honeycombing, spalls, surface blemishes, etc. to match adjacent undamaged surfaces.
  - 2. Build mockups full-size, matching site concrete components indicated on the Drawings. Mock-ups shall be complete in every detail, including joints, reveals, edges, chamfers, etc. Include complex joinery conditions where necessary to integrate to other Project components as indicated including multiple pour conditions. Mockups should be provided for each finish, color, joint and detail specified.
  - 3. Maintain accurate records of variables associated with each mockup to facilitate the matching of accepted mockups during actual construction.
  - 4. Demonstrate curing, cleaning, and protecting of cast-in-place concrete paving, finishes, and contraction and expansion joints, as applicable.
  - 5. Mockup Acceptance: Obtain Architect's approval of mockups before casting architectural site concrete and paving.
    - a. The Architect may reject mockups that, in the Architect's sole judgment, do not demonstrate an acceptable completed product, including, but not limited to, color, joint work, surface finish, texture, tolerances, and standard of workmanship
    - b. The Architect may require modifications to mockups to obtain acceptable results.
    - c. The Architect may require modifications to mockup repairs to obtain acceptable results.
    - d. The Architect may require removal and reconstruction of mockups to obtain acceptable results. Multiple mock ups maybe required.
    - e. Contractor shall provide additional mockups as required to obtain results acceptable to the Architect at no additional cost to the Owner.

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6. Mockup Disposition: Accepted mockups shall not become part of the completed Project. Maintain mockup onsite for the duration of construction and until all work has been accepted. Remove and legally dispose mockups after acceptance of final installed work. prior to Project Completion. If sufficient permanent concrete paving work has been completed, Contractor may submit a written request to Architect to transfer quality control for concrete paving from the accepted mockups to one or more designated portions of the permanent work.
7. Provide written meeting minutes for each mock up review indicating items reviewed, approvals, rejections, connections, or other action items.

#### **1.07 PROJECT CONDITIONS**

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending, damage, and rust.
  1. Label bundles with durable identification tags. Maintain reinforcement identification after bundles are broken.
  2. Store reinforcement to avoid excessive rusting or fouling with grease, oil, dirt or other bond-weakening contaminants.
  3. Avoid damaging applied coatings, if any, on steel reinforcement.

### **PART 2 - PRODUCTS**

#### **2.01 FORMS**

- A. Formwork: / Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth surfaces.
  1. Set forms to alignment, grade and required dimensions. Formwork shall not deviate more than 1/4 inch from required vertical positions and 1/4 inch from required horizontal positions. Exposed Surfaces: Provide faced plywood panels complying with, or equivalent to, DOC PS 1, Structural I. Provide minimum 7-ply plywood and provide balance sheets for panels coated one-side only. Furnish in largest practicable sizes to minimize number of joints. Provide Medium-Density Overlay (MDO) panels or high density overlay (HDO) panels, with mill-applied release agent and edge sealant. Provide one of the following panels, or comparable substituted product:
    - a. Olympic Panel Products, "B-Matte 333 MDO Concrete Form." Overlay Color: Brown.
    - b. Pacific Laminate Products, "ProFace MDO." Overlay Color: Black.
    - c. Sylvan Products, LLC, "Armor Ply MDO" Overlay Color: Brown.
  2. Hold forms rigidly in place by stakes, clamps, spreaders, and braces at 3 feet on centers, and where required to ensure rigidity.
  3. 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.
  4. Place joint filler or backer rod on vertical surfaces in contact with concrete paving.
  5. Benders or thin plank forms may be used on curves, grade changes, or curb returns. Back forms for curb returns may be made of 1/2-inch thick benders cleated together for full depth of the curb.
  6. Keep forms in place until concrete is sufficiently hard to prevent damage to concrete.
  7. Reuse of Forms:
    - a. Do not reuse forms if there is any evidence of surface wear or defect which would impair quality of surface or edge.

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- b. Thoroughly clean and properly coat forms before reuse.
  - c. Do not use forms from previous projects.
- 8. Provide new forms specifically purchased for this project. Reuse of forms from past projects or contractors stock will not be accepted.
- B. Curved Work: Kerf back of plywood form-facing panels, or use accepted flexible or curved forms for curved work with a radius of 100 feet or less.
- C. 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.
  - 1. Obtain written acceptance of form release agent from integral colored concrete pigment manufacturer.
  - 2. Form-release agents shall be non-staining and can cause no visual effect to the finish.
  - 3. Formulate form-release agent with rust inhibitor for steel form-facing materials.

## 2.02 STEEL REINFORCEMENT

- A. Recycled Content: Provide steel reinforcement with an average recycled content of steel so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 60 percent.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.
- C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- D. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.
- E. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- F. Low-Alloy-Steel Reinforcing Bars (for Welding): ASTM A 706/A 706M, Grade 60, deformed, unless otherwise indicated.
- G. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.
  - 1. Provide two-component "Speed Dowel System" manufactured by Greenstreak.
- H. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- I. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- J. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
  - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
- K. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- L. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
- M. Zinc Repair Material: ASTM A 780.

## 2.03 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
  - 1. Portland Cement: ASTM C 150, Type II/V, Type I/II or Type IV, gray, unless white cement is required to achieve colors indicated. Supplement with the following:

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- a. Fly Ash: ASTM C 618, Class F.
  - b. Fly Ash: none accepted.
- B. Normal-Weight Aggregates: ASTM C 33, complying with building code. Provide aggregates from a single source. All aggregates shall be free of materials with deleterious reactivity to alkali in cement when tested in accordance with ASTM C 289.
  - 1. Comply with CBC section 1903A.3.
  - 2. Comply with CBC section 1903.3.
  - 3. Service Class, based on CBC Figure 1904A.2., "Weathering Probability Map":
    - a. Severe and Moderate: Class 5S.
    - b. Negligible: Class 2N.
  - 4. Service Class, based on CBC Figure 1904.2., "Weathering Probability Map":
    - a. Severe and Moderate: Class 5S.
    - b. Negligible: Class 2N.
  - 5. Maximum Coarse-Aggregate Size: 3/8 inch nominal.
    - a. Source: Reliance, Vulcan, San Gabriel, or Carrol Canyon
    - b. Hard rock mix; no pea gravel will be accepted.
  - 6. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
    - a. Source: Reliance, Foster, Corona
    - b. Color to be white to light no dark material.
- C. Water: Potable and complying with ASTM C 94/C 94M.
- D. Shrinkage-Reducing Admixture: Commercially formulated, shrinkage inhibitor capable of reducing initial shrinkage by 80% and long-term shrinkage by 50%. Provide product suitable for use with either air-entrained or non-air-entrained concrete as appropriate to structural member and project location.
  - 1. Products: Subject to compliance with requirements, provide one of the following(as required):
    - a. Euclid Chemical Company (The), an RPM company; EUCON SRA, SRA+.
    - b. Grace Construction Products, W. R. Grace & Co.; Eclipse Floor, Eclipse Plus.
    - c. Sika Corporation; Control 40.

## 2.04 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry or cotton mats.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete. Provide products with not more than 100g/L volatile organic content.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Construction Chemicals, LLC; Confirm.
    - b. Conspec by Dayton Superior; Aquafilm.
    - c. Nox-Crete Products Group; MONOFILM.
- E. Clear, Waterborne, Membrane-Forming Curing Compound (Colored Concrete): Provide products that are acceptable to concrete color pigment manufacturer complying with ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of sealers with no glossy finish and compatible with specified sealer. Provide products with not more than 100g/L volatile organic content.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Sinak Corporation; The Cure WCE or Lithium Cure 1000.
    - b. L. M. Scofield; Cureseal-W.
    - c. Butterfield Color; Clear Guard H2O.

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- F. All curing materials should be dissipating without leaving a shiny, cloudy, or glossy finish. Curing material does not substitute requirement of a sealer.

## **2.05 STENCIL MATERIALS**

- A. Stencils: Manufacturer's standard, moisture-resistant paper or reusable plastic stencils, designed for use on plastic concrete.
- B. Stencils: Manufacturer's standard, moisture-resistant paper or reusable plastic stencils, designed for use on concrete.
- C. Shop drawings for all stencils.
- D. Products: Subject to compliance with requirements.

## **2.06 HARDENERS AND SEALERS**

- A. Penetrating Liquid Floor and Horizontal Surface Treatment (Sealer): Clear, chemically reactive, waterborne solution of inorganic silicate or silicate water-based lithium quartz materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces. Materials shall be compatible with concrete admixtures and shall be recommended by manufacturer for intended use. Provide product with 0g/L volatile organic content.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Sinak Corporation; Concrete Sealer HLQ 125.
    - b. L. M. Scofield; Cureseal-W.
    - c. Butterfield Color; Clear Guard H2O.
    - d. BASF Construction Chemicals - Building Systems; Kure-N-Harden.
    - e. Dayton Superior Corporation; Edoco by Dayton Superior; Titan Hard.
    - f. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
    - g. L&M Construction Chemicals, Inc.; Seal Hard.

## **2.07 AGGREGATE BASE**

- A. Granular Fill: Class II crushed aggregate per Section 26 of Cal-Trans standards. Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.
- B. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch (9.5-mm), 20 to 10 / 10 to 30 percent passing a No. 100 (0.15-mm) sieve, and at least 0-5 percent passing No. 200 (0.075-mm) sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

## **2.08 RELATED MATERIALS**

- A. Joint Fillers:
  - 1. Ceramar by W.R. Meadows. A closed cell isomeric polymer synthetic foam ASTM D 5249, Type 2.
  - 2. Deck-O-Foam polyethylene by W.R. Meadows. A closed cell expansion joint filler ASTM D 4819
  - 3. Asphalt-saturated cellulosic fiber in preformed strips, ASTM D 1751
  - 4. 1/4" thickness.
- B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- C. Bonding Agent: ASTM C 1059, Type II, non-re-emulsifiable. Provide proprietary products composed of latex polymers.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. W. R. Meadows, Inc.; "Acry-Lok".

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- b. Grace Construction Products, W. R. Grace & Co.; "Daraweld C".
  - c. Larsen Products Corp., "Weld-Crete".
- D. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
  - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete, and for anchoring dowels to hardened concrete.

## 2.09 DETECTABLE WARNING MATERIALS

- A. General: All detectable warning systems shall comply with Americans with Disabilities Act (28 CFR Part 36 ADA Standards for Accessible Design, Appendix A, Section 4.29.2 Detectable Warnings on Walking Surfaces), and CBC requirements (Section 11B-247, 11B-705 and others). All detectable warning materials shall have raised truncated domes with a base diameter of nominal 0.90 inch (22.9 mm), tapering to a top diameter of 0.45 inch (11.4 mm), a height of nominal 0.20 inch (5.08 mm), and a center-to-center spacing of 2.35 inches (59.7 mm) nominal. The orientation of the dome pattern for all panels shall be parallel with the panel edges. Detectable warning materials shall visually contrast with surrounding areas.
  - 1. California Compliance Warranty: All detectable warning systems shall be approved by DSA-AC. If not approved, DSA will accept a written five (5) year product warranty provided by the manufacturer of detectable warning products and directional surfaces. Such warranty shall indicate compliance with architectural standards as published in the current edition of the California Building Standards Code, and also include durability criteria which indicate that the shape, color fastness, confirmation, sound-on-cane acoustic quality, resilience, and attachment will not degrade significantly for at least five (5) years after initial installation. As defined by the State, "not degrade significantly" means that the product maintains at least 90 percent of its approved design characteristics, as determined by the enforcing agency.
- B. Safety Step TD (Surfaced Truncated Domes)
  - 1. Traditional System
  - 2. Ramp Up System
    - a. Power Bond option
  - 3. Contact Ron Hager 909-809-4018
- C. Engineered Plastics, Inc., Armor Tile Tactile Systems, Surface-Mounted Truncated Dome Detectable Warning Tile.
  - 1. Size: As indicated or required.
  - 2. Color: Federal Yellow No. FS 33538 of SAE AMS-STD-595A **per Code Supplement 11B-705.1.1.3.1**
- D. Concrete Paver Detectable Dome Warning System: Provide standard size precast architectural concrete paving units for installation in sand or mortar beds.
  - 1. Basis-of Design Product: Provide the following, or comparable substitute product:
    - a. Acker-Stone Industries, Inc., ADA Pavers-Truncated Domes.
      - 1) Size: per approved plans and details. Nominal 12 inches by 12 inches by 2 3/8 inches (4.7 cm by 4.7 cm by 6 cm).
      - 2) Color: per approved plans and details. As selected by Architect from manufacturer's complete range.
    - b. Tectura designs - ADA-2 Truncated dome pavers.
      - 1) 12 inches by 12 inches nominal(actual 11.8 inches X 11.8 inches) by 2 3/8 inches
      - 2) Color as selected by Architect from manufacturer's complete range.

## 2.10 PAVEMENT MARKINGS

- A. Color: As indicated on plans.

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- B. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.
  - 1. Color: White, green, unless otherwise indicated. Use for non-accessible striping, directional arrows, numbering, and lettering.
  - 2. Accessibility Color: Paint accessibility lines and markings blue color equal to Color No. 15090 per Federal Specification 595C.

## 2.11 WHEEL STOPS

- A. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 6 inches high by 7 inches wide by 72 inches long at singles stalls and XX inches long at shared stalls. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.
  - 1. Dowels: Galvanized steel, 5/8 inch in diameter, 18-inch minimum length.

## 2.12 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), 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.
  - 2. Proportioning:
    - a. The proportioning of ingredients shall be such that the concrete can be readily worked into forms and around reinforcement under the conditions of placement to be used, without segregation or excessive bleeding.
    - b. When proportioning by weight of loose, dry material, 94 pounds of cement shall be considered 1 cubic foot.
      - 1) Float/Broom Finish: Coarse aggregate 50 percent-50 percent fine aggregate.
      - 2) Retarder finish: Coarse aggregate 40 percent, fine aggregate 60 percent.
      - 3) Exposed Aggregate Finish: Coarse aggregate 65 percent, fine aggregate 35 percent.
      - 4) Abrasive blast finish: Coarse aggregate 40 percent, fine aggregate 60 percent.
    - c. Total water content shall not exceed 35 gallons per cubic yard of concrete.
    - d. Weighing equipment shall be accurate within 1 pound and shall be adjustable for varying aggregate moisture content.
    - e. A beam auxiliary shall register any part of the last 100 pounds of each aggregate. The aggregate hopper shall have a volume adjustment.
  - 3. Prepare compressive strength data for both 7-day and 28-day strengths.
    - a. The 7-day compressive strength shall be at least 60 percent of the required 28-day strength.
    - b. The 28-day compressive strength shall be as indicated.
    - c. Provide drying shrinkage test data at 28 days, from not less than 3 test specimens.
- B. When automatic machine placement is used, prepare and submit design mixtures suitable for use with machine placement, including reduced slump as required. Obtain laboratory test results that meet or exceed requirements.
- C. Proportion mixtures to provide normal-weight concrete with the following properties:
  - 1. Typical Compressive Strength (28 Days): Provide the following minimum compressive strength (28 days) for concrete paving unless otherwise indicated: 3000 psi.
  - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50-0.60.
  - 3. Slump Limit: 4 inches, plus or minus 1 inch, unless indicated otherwise.
    - a. Slump Limit (High-Range Water-reducing Admixture): 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture, plus or minus 1 inch, unless indicated otherwise.
    - b. Slump Limit (Plasticizing Admixture): 8 inches for concrete with verified slump of 2 to 4 inches before adding plasticizing admixture, plus or minus 1 inch, if required.

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- D. Air Content, Exterior Exposed Concrete: Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having the following air entrainment for all exposed concrete with a weathering probability of severe or moderate per CBC Figure 1904.2.2/1904A.2.2:
  - 1. Provide air entrainment of 6.0 percent, plus or minus 1.5 percent at point of delivery for 1-inch and 3/4-inch nominal maximum aggregate size, if required unless indicated otherwise.
- E. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement. Limit total chloride-ion content in hardened concrete to 0.10 percent by weight of concrete when tested per AASHTO T 260 potentiometric titration.
- F. Limit "drying shrinkage" after 28 days of curing hardened concrete to 0.045 percent of the original concrete volume.
- G. Limit water-soluble, chloride-ion content in hardened concrete to [0.15] [0.30] percent by weight of cement.
- H. Chemical Admixtures: Admixtures may only be used if they are incorporated into the accepted concrete mix designs. Use admixtures according to manufacturer's written instructions.
  - 1. Use [water-reducing admixture] [high-range, water-reducing admixture] [high-range, water-reducing and retarding admixture] [plasticizing and retarding admixture] in concrete as required for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
  - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- I. Liquid Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with accepted mockup.
- J. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb./cu. yd. (0.60 kg/cu. m).

## 2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M[ and ASTM C 1116/C 1116M]. Furnish batch certificates for each batch discharged and used in the Work.
  - 1. When air temperature is between 85 and 90 deg. F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg. F (32 deg. C), reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
- C. For concrete batches of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
- D. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
- E. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.
- F. Integral Colored Concrete Mixes: Add pigments at the concrete batch plant. Minimum batch size shall be three (3) yards. The same brand of cement, source of sand, and water/cement ratio shall be maintained for each load of the same color.

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1. Batching Procedure: Before adding color-conditioning admixture, the mixing drum shall be thoroughly cleaned and wetted with approximately 40 gallons of the mix water and/or a portion of the aggregates. After cleaning and wetting of the drum, add the specified quantity of admixture correctly packaged for the mix design and batch quantity. Proceed with normal batching of balance of ingredients. After loading is complete, mix at mixing speed for a minimum of 15 minutes. Do not add water after a portion of the load has been discharged.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
  1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
  2. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Division 31 Section "Earth Moving."
- C. Proceed with concrete paving installation only after unsatisfactory conditions have been corrected.

#### **3.02 PREPARATION**

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

#### **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.
- C. Slope stair and step treads at not less than 1.0 percent and not more than 2.0 percent cross slope to drain.

#### **3.04 STEEL REINFORCEMENT**

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.
- E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

#### **3.05 JOINTS**

- A. General: Form construction, isolation or expansion joint, and saw cut / 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.

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- B. Isolation (Expansion) Expansion Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
  - 1. Locate expansion joints at intervals of 20 feet maximum unless otherwise indicated.
  - 2. Extend joint fillers full width and depth of joint and recess 1 inch from finish surface where no joint sealant is indicated.
  - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
  - 4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
  - 5. Break steel at expansion joints.
  - 6. Dowels- provide prefabricated 'speed dowel' assemblies.
- C. Saw Cut (Control) Joints: Form weakened-plane saw cut joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth plus 1/4 inch of the concrete thickness, as follows, and to match jointing of existing adjacent concrete paving:
  - 1. Continue steel reinforcement across sawcut joints unless otherwise indicated.
- D. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/8-inch radius unless otherwise noted. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

### 3.06 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in. Notify other trades as necessary to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to 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.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. 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.
- G. 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, reinforcement, and side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. 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.
- J. Curbs and Gutters: Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use accepted design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

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- L. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
- M. Cold-Weather 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 (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg. F (10 deg C) and not more than 80 deg. F (27 deg C) 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.
- N. Hot-Weather Placement: Comply with ACI 305R (ACI 305R M) and as follows when hot-weather conditions exist:
  - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg. F (32 deg C) 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, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.
- O. Provide sand and base materials as indicated.

### 3.07 FLOAT/BROOM 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.
  - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
  - 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture. Required to meet slip coefficient requirement.
  - 3. Portland cement concrete paving shall be stable, firm, and slip resistant and shall comply with **CBC Sections 11B-302 and 11B-403**.

### 3.08 SPECIAL FINISHES

- A. Cure concrete with curing compound recommended by dry-shake hardener manufacturer. Apply curing compound immediately after final finishing.
- B. High-Pressure Water-Jet Finish: Perform high-pressure water jetting on concrete that has achieved a minimum compressive strength of 4500 psi. Coordinate with formwork removal to ensure that surfaces to be high-pressure water-jet finished are treated at same age for uniform results.
- C. Surface Continuity: Perform high-pressure water-jet finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances in reveal projection to match design reference sample or mockup.

### 3.09 DETECTABLE WARNINGS

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- A. Detectable Warnings, General: Install detectable warnings as part of the concrete paving placement sequence. Set true to line and elevation. Comply with maximum slope and cross-slope requirements for accessible walkways.
  - 1. Blockouts: Form blockouts in concrete and asphalt pavements for installation of detectable paving units.
    - a. Tolerance for Opening Size: Plus 1/4 inch, no minus.
- B. Detectable warnings surfaces shall comply with **CBC Section 11B-705.1**.
- C. Detectable warning surfaces shall be yellow conforming to **FS 33538 of SAE AMS-STD-595A per Code Supplement** except for locations at curb ramps, islands, or cut through medians where color used shall contrast visually with that of adjacent walking surfaces, either light-on-dark or dark-on-light. **CBC Sections 11B-705.1.1.3 and 11B-705.1.1.5**.
- D. Detectable warning surfaces shall differ from adjoining surfaces in resiliency or sound-on-cane contact. **CBC Section 11B-705.1.1.4**.
- E. Provide 5 year minimum warranty per **DSA Bulletin 10/31/02, revised 04/09/08**.
- F. Precast Detectable Warning Tiles: Comply with approved plans and details along with manufacturer's written instructions.
- G. Surface-Mounted Detectable Warning Tiles: Comply with manufacturer's written instructions. Do not install directly over asphalt pavements.
- H. For installation at asphalt pavements, comply with installation indicated on Drawings. If not indicated, provide one of the following installation methods:
- I. Saw-cut and remove asphalt pavement in location of warning tile to a minimum depth of 6 inches. Replace removed pavement materials with reinforced concrete paving materials. When cured, install surface-mounted detectable warning tiles.
- J. Provide 0.032 inch aluminum separation sheet cut to same size as surface mounted tiles. Adhere sheet to asphalt paving with a thin coat of urethane adhesive, holding adhesive 1 inch from edge of sheet. Install surface-mounted detectable warning tiles to sheet with adhesive and mechanical fasteners per manufacturer's written instructions.
- K. Cast-in-Place Detectable Warning Pavers: Integrate into installation of unit pavers. Comply with manufacturer's written instructions.
- L. Cast-in-Place Detectable Warning Grooves: Install detectable warnings as part of the concrete paving placement sequence. Set true to line and elevation. Form well-defined, clean grooves with appropriate tools.

### 3.10 CONCRETE PROTECTION, CURING AND SEALING:

- 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.
- 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 before 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 Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.

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- c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
  3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.
- F. Seal Concrete: Apply specified sealer in accordance with manufacturer's recommendations.
1. Apply full strength in two coats with airless sprayer at the manufacturer's recommended rate.
  2. After the first coat is completely dry, apply second coat at right angles to the first coat.

### 3.11 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117, the Americans with Disabilities Act, the CBC and as follows:
  1. Elevation: 1/8 inch.
  2. Thickness: Plus 3/8 inch, minus 1/4 inch.
  3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/8 inch. Surface must properly drain.
  4. Surface Discontinuities: Maximum 1/4 inch, subject to further limitations of accessible routes.
  5. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
  6. Lateral Alignment and Spacing of Dowels: 1/4 inch.
  7. Vertical Alignment of Dowels: 1/8 inch.
  8. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/8 inch per 12 inches of dowel.
  9. Joint Spacing: 3 inches, except joint position shall be within 1/4 inch of objects in alignment with joint such as benches, light poles, pull boxes, etc.
  10. Sawcut Joint Depth: Plus 1/4 inch, no minus.
  11. Joint Width: Plus 1/16 inch, no minus.
- B. Stair Treads: Stair treads within a run shall be constructed equally and shall shed water away from the path of travel. Maximum tread slope down from riser to nosing in direction of travel: 1.0 percent, plus or minus 0.5 percent. Maximum tread cross-slope perpendicular to direction of travel: 2.0 percent, plus 0.0 percent, minus 1.0 percent or as required to shed water.
- C. Ramps: Ramps shall shed water away from the path of travel. Maximum ramp slope in direction of travel: 8.33 percent. Maximum ramp cross-slope perpendicular to direction of travel: 2.0 percent, plus 0.0 percent, minus 1.0 percent or as required to shed water.

### 3.12 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils. Provide markings with a minimum width of 3 inches.

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1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
  2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb./gal.
- E. Accessible parking spaces serving a particular building or facility shall be located, and dispersed if serving more than one accessible entrance, on the shortest accessible routes to an entrance or to multiple accessible entrances. **CBC Section 11B-208.3.1.**
- F. Accessible parking spaces in a parking facility not serving a particular building or facility shall be located on the shortest accessible route to an accessible pedestrian entrance of the parking facility. **CBC Section 11B-208.3.1.**
- G. Minimum number of required accessible parking spaces shall be provided in accordance with **CBC Table 11B-208.2** for each parking facility provided.
- H. For every six or fraction of six accessible parking spaces, at least one shall be an accessible van parking space. **CBC Section 11B-208.3.1.**
- I. Accessible parking spaces and access aisles shall comply with **CBC Section 11B-502** and shall be dimensioned to the centerlines of the marked lines as follows:
1. Parking spaces and access aisles shall be marked according to **CBC figures 11B-502.2, 11B-502.3, and 11B-502.3.3**. Their surfaces shall comply with **CBC Section 11B-302** and shall be at the same level with the slopes not steeper than 1:48 in any direction. **CBC Section 11B-502.4.**
  2. Parking spaces shall be 9'x18' minimum and van parking spaces shall be 12'x18' minimum with an adjacent access aisle of 5'x18' minimum. Access aisles shall be placed on either side of the parking spaces except be located on the passenger side for van parking spaces. Van parking spaces shall be permitted to be 9'x18' minimum where the access aisle is 8'x18' minimum.
  3. Access aisles shall be marked by a blue painted borderline around their perimeter. The areas within the blue borderlines shall be marked with hatched lines a maximum of 36" on center in a color contrasting with that of the aisle surface, preferably blue or white. Access aisle markings may extend beyond the minimum required length. **CBC Section 11B-502.3.3**
  4. Access aisles (parking spaces as well- similar application) shall not overlap the vehicular way. **CBC Section 11B-502.3.4**
  5. A vertical clearance of 8'-2" minimum shall be provided for accessible parking spaces, access aisles, and vehicular routes serving them. **CBC Section 11B-502.5**
- J. At least one passenger loading zone shall be provided in every continuous 100 linear feet of loading zone space, or fraction thereof, complying with **CBC Section 11B-209 and 11B-503** as follows:
1. Vehicle pull-up spaces shall be 8' x 20' minimum. Access aisles shall be 5' x 20' minimum and shall be adjacent and parallel to the vehicular pull-up spaces. They shall be the same level with slopes not steeper than 1:48 in any direction. **CBC Section 11B-503.4.**
  2. Access aisles for passenger drop-off and loading zones shall be marked with a painted borderlines around their perimeter. The areas within the borderlines shall be marked with hatched lines a maximum of 36" on center in a color contrasting with that of the aisle surface. **CBC Section 11B-503.3.**
  3. A vertical clearance of 9'-6" minimum shall be provided for vehicle pull-up spaces, access aisles, and a vehicular route serving them connecting a vehicular entrance and a vehicular exit. **CBC Section 11B-503.5.**

### 3.13 WHEEL STOPS

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- A. Securely attach wheel stops to paving with not less than two #5 galvanized steel dowels, minimum 24 inches long, located at one-quarter to one-third points. Install dowels in drilled holes in the paving and bond dowels to wheel stop. Recess head of dowel beneath top of wheel stop.
- B. Install preformed speed [bumps] [humps] [cushions] in bed of adhesive applied as recommended by manufacturer for heavy traffic.
- C. Securely attach preformed speed [bumps] [humps] [cushions] to paving with hardware spaced as recommended by manufacturer for heavy traffic. Recess head of hardware beneath top surface.

### 3.14 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
  - 1. Testing Frequency: Obtain at least one composite sample for each 20 cu. Yd., or fraction thereof of each concrete mixture placed each day.
    - 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 C 143/C 143M; 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 C 231, 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 C 1064/C 1064M; 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 C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
  - 6. Compressive-Strength Tests: ASTM C 39/C 39M; 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 Owner, 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. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements. Concrete paving will be considered defective if it does not pass tests and inspections.

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- 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.

### **3.15 REPAIRS AND PROTECTION**

- A. Remove and replace concrete paving that is broken, damaged, cracked, chipped, stained or defective or that does not comply with requirements in this Section as determined by Landscape Architect. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with Portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude all but pedestrian traffic from paving for at least 28 days after placement. When construction traffic is permitted, maintain paving as clean as possible by providing adequate surface protection and by removing surface stains and spillage of materials as they occur.
  - 1. Rubber tire marks are unacceptable in the completed construction.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Project Completion inspections.
- E. Repair of damaged, defective or rejected concrete is not permitted. Remove all concrete from expansion joint to expansion joint or greater as required to provide a constant continuous finish.

### **3.16 FINAL CLEANING**

- A. Remove all excess concrete, form materials, over pours, waste, etc., and legally dispose off-site.
- B. Provide a final acid and power wash for all concrete paving surfaces. Do not use any material that will affect the appearance of the concrete.
- C. All over pours in planting areas should be removed prior to landscape operations.
- D. Clean concrete paving to remove stains, markings, dust, and debris.

**END OF SECTION 32 1313**

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## SECTION 32 1373 PAVEMENT JOINT SEALERS

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES: RELATED DOCUMENTS

- A. Exterior joint sealant for non-traffic surfaces.

#### 1.02 RELATED REQUIREMENTS

- A. Division 32 Section Concrete Paving.

#### 1.03 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Verification: For each type and color of joint sealant required. Install joint-sealant samples in 1/2-inch- (13-mm-), and 1/4-inch (6.4-mm) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
- D. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

#### 1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- B. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
- C. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
- D. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
- E. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
- F. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

#### 1.06 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
- B. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).
- C. When joint substrates are wet or covered with frost.
- D. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

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- E. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

### **2.02 MATERIALS, GENERAL**

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Landscape Architect from manufacturer's full range.

### **2.03 ELASTOMERIC JOINT SEALANTS**

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Multicomponent Pourable Urethane Sealant (Sealant #1):
1. Available Products:
    - a. Bostik Findley; Chem-Calk 550.
    - b. Meadows, W. R., Inc.; Pourthane.
    - c. Pacific Polymers, Inc.; Elasto-Thane 227 Type I (Self Leveling).
    - d. Pecora Corporation; Urexpan NR-200.
    - e. Polymeric Systems Inc.; PSI-270SL.
    - f. Schnee-Morehead, Inc.; Permthane SM 7201.
    - g. Sika Corporation, Inc.; Sikaflex - 2c SL.
    - h. Sonneborn, Division of ChemRex Inc.; SL 2.
    - i. Tremco; THC-900/901.
    - j. Tremco; Vulkem 245.
  2. Type and Grade: M (multicomponent) and P (pourable).
  3. Class: 25.
  4. Use Related to Exposure: T (traffic).
  5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
- D. Multicomponent Nonsag Urethane (Sealant #2):
1. Available Products:
    - a. Pacific Polymers, Inc.; Elasto-Thane 227 High Shore Type II (Gun Grade).
    - b. Pecora Corporation; Dynatred.
    - c. Polymeric Systems Inc.; PSI-270.
  2. Type and Grade: M (multicomponent) and NS (nonsag).
  3. Class: 25.
  4. Use Related to Exposure: T (traffic).
  5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

### **2.04 JOINT-SEALANT BACKER MATERIALS**

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- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

## **2.05 PRIMERS**

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 PREPARATION**

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

### **3.03 INSTALLATION OF JOINT SEALANTS**

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of backer materials.
  - 2. Do not stretch, twist, puncture, or tear backer materials.
  - 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses provided for each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.
- F. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

### **3.04 CLEANING**

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- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

### **3.05 PROTECTION**

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

### **3.06 SCHEDULE**

- A. Horizontal Joints, less than 5 percent slope; Sealant No. 1.
- B. Horizontal Joints, grades steeper than 5 percent; Sealant No. 2
- C. Vertical Joints; Sealant No. 2

**END OF SECTION 32 1373**

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## SECTION 32 1723.13 PAINTED PAVEMENT MARKINGS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Parking lot markings, including parking bays, crosswalks, arrows, handicapped symbols, and curb markings.
- B. Roadway lane markings and crosswalk markings.
- C. "No Parking" curb painting.

#### 1.02 RELATED REQUIREMENTS

- A. Section 32 1216 - Asphalt Paving.

#### 1.03 REFERENCE STANDARDS

- A. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association.
- B. California MUTCD - Manual on Uniform Traffic Control Devices for Streets and Highways; State of California Department of Transportation (FHWA's MUTCD as amended for use in California); current edition.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for 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.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint in containers of at least 5 gallons 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.

#### 1.06 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. Line and Zone Marking Paint: MPI (APL) No. 97 Latex Traffic Marking Paint; color(s) as indicated.
  - 1. Parking Lots: Yellow.
  - 2. Accessible Symbols: Blue.
  - 3. Fire Lane ("No Parking"): Red with white lettering.
- B. Temporary Marking Tape: Preformed, reflective, pressure sensitive adhesive tape in color(s) required; Contractor is responsible for selection of material of sufficient durability as to perform satisfactorily during period for which its use is required.

### 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.

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### 3.02 PREPARATION

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Clean surfaces thoroughly prior to installation.
  1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods.
  2. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement, by scraping, wire brushing, sandblasting, mechanical abrasion, or approved chemicals.
- D. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.
- E. Establish survey control points to determine locations and dimensions of markings; provide templates to control paint application by type and color at necessary intervals.
- F. Temporary Pavement Markings: When required or directed by Architect, apply temporary markings of the color(s), width(s) and length(s) as indicated or directed.
  1. After temporary marking has served its purpose, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that surface to which the marking was applied will not be damaged.
  2. At Contractor's option, temporary marking tape may used in lieu of temporary painted marking; remove unsatisfactory tape and replace with painted markings at no additional cost to Owner.

### 3.03 REQUIREMENTS

- A. Accessible parking spaces serving a particular building or facility shall be located, and dispersed if serving more than one accessible entrance, on the shortest accessible routes to an entrance or to multiple accessible entrances. **CBC Section 11B-208.3.1.**
- B. Accessible parking spaces in a parking facility not serving a particular building or facility shall be located on the shortest accessible route to an accessible pedestrian entrance of the parking facility. **CBC Section 11B-208.3.1.**
- C. Minimum number of required accessible parking spaces shall be provided in accordance with **CBC Table 11B-208.2** for each parking facility provided.
- D. For every six or fraction of six accessible parking spaces, at least one shall be an accessible van parking space. **CBC Section 11B-208.2.4.**
- E. Accessible parking spaces and access aisles shall comply with **CBC Section 11B-502** and shall be dimensioned to the centerline of the marked lines as follows:
  1. Parking spaces and access aisles shall be marked according to **CBC Section 11B-502.2, 11B-502.3, and 11B-502.3.3.** Their surfaces shall comply with **CBC Section 11B-302** and shall be at the same level with slopes not steeper than 1:48 in any direction. **CBC Section 11B-502.4.**
  2. Parking spaces shall be 9' x 18' minimum and van parking spaces shall be 12' x 18' minimum with an adjacent access aisle of 5' x 18' minimum. Access aisles shall be placed on either side of the parking spaces except be located on the passenger side for van parking spaces. Van parking spaces shall be permitted to be 9' x 18' minimum where the access aisle is 8' x 18' minimum.

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3. Access aisles shall be marked by a blue painted borderline around their perimeter. The area within the blue borderlines shall be marked with hatched lines a maximum of 36" on center in a color contrasting with that of the aisle surface, preferably blue or white. Access aisle markings may extend beyond the minimum required length. **CBC Section 11B-502.3.3.**
  4. Access aisles (parking spaces as well - similar application) shall not overlap the vehicular way. **CBC Section 11B-502.3.4.**
  5. A vertical clearance of 8'-2" minimum shall be provided for accessible parking spaces, access aisles, and vehicular routes serving them. **CBC Section 11B-502.5**
- F. At least one passenger loading zone shall be provided in every continuous 100 linear feet of loading zone space, or fraction thereof, complying with **CBC Section 11B-209 and 11B-503** as follows:
1. Vehicle pull-up spaces shall be 8' x 20' minimum. Access aisles shall be 5' x 20' minimum and shall be adjacent and parallel to the vehicular pull-up spaces. They shall be the same level with slopes not steeper than 1:48 in any direction. **CBC Section 11B-503.4.**
  2. Access aisles for passenger drop-off and loading zones shall be marked with a painted borderlines around their perimeter. The areas within the borderlines shall be marked with hatched lines a maximum of 36" on center in a color contrasting with that of the aisle surface. **CBC Section 11B-503.3.**
  3. A vertical clearance of 9'-6" minimum shall be provided for vehicle pull-up spaces, access aisles, and a vehicular route serving them connecting a vehicular entrance and a vehicular exit. **CBC Section 11B-503.5.**
- G. Bus loading zones and bus stops shall comply with **CBC Sections 11B-209 and 11B-810.2** as follows:
1. Boarding and alighting areas shall be 8' x 5' minimum, with 8' measured perpendicular to the curb or vehicle roadway edge, and with 5' measured parallel to the vehicle roadway. Slopes in 8' direction shall be 1:48 maximum. Slopes in 5' direction shall be the same as that of the roadway, to the maximum extent practicable. **CBC Figure 11B-810.2.2.**
  2. Bus shelters shall provide a minimum 30" x 48" clear floor or ground space (36" x 48" or 36" x 60" as applicable in an alcove), with slopes not steeper than 1:48 in any direction, entirely within the shelter complying with **CBC Section 11B-305.**
  3. Bus shelters shall be connected by an accessible route complying with **CBC Section 11B-402** to a boarding and alighting area complying with **CBC Section 11B-810.2.** **CBC Figure 11B-810.3.**

### 3.04 INSTALLATION

- A. Begin pavement marking as soon as practicable after surface has been cleaned and dried.
- 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.
- C. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.
- D. Comply with California MUTCD manual for details not shown.
- E. Apply markings in locations determined by measurement from survey control points; preserve control points until after markings have been accepted.
- F. Apply uniformly painted markings of color(s), lengths, and widths as indicated on drawings true, sharp edges and ends.
  1. Length Tolerance: Plus or minus 3 inches.
  2. Width Tolerance: Plus or minus 1/8 inch.
- G. Parking Lots: Apply parking space lines, entrance and exit arrows, painted curbs, and other markings indicated on drawings.

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1. Mark the "International Symbol of Accessibility" (ISA) at indicated parking spaces.
  2. Hand application by pneumatic spray is acceptable.
- H. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.

### **3.05 DRYING, PROTECTION, AND REPLACEMENT**

- A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.
- B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.
- C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.
- D. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.
- E. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.
- F. Replace removed markings at no additional cost to Owner.

**END OF SECTION 32 1723.13**

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## SECTION 32 1726 TACTILE WARNING SURFACING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Plastic tactile and detectable warning tiles for pedestrian walking surfaces.

#### 1.02 RELATED REQUIREMENTS

- A. Section 32 1313 - Concrete Paving: Concrete sidewalks.
- B. Section 32 1723.13 - Painted Pavement Markings: Crosswalk and curb markings.

#### 1.03 REFERENCE STANDARDS

- A. 49 CFR 37 - Transportation Services for Individuals with Disabilities (ADA).
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design.
- C. ATBCB PROWAG - Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way.
- D. SAE AMS-STD-595 - Colors Used in Government Procurement.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. 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.

#### 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 7800 - Closeout Submittals, for additional warranty requirements.
- B. Plastic Tiles: Provide manufacturer's standard five year warranty against manufacturing defects, breakage or deformation.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Plastic Tactile and Detectable Warning Surface Tiles:

#### 2.02 TACTILE AND DETECTABLE WARNING DEVICES

- A. Plastic Tactile and Detectable Warning Tiles: ADA Standards compliant, glass fiber and carbon fiber reinforced, exterior grade, matte finish polyester sheet with truncated dome pattern, solid color throughout, internal reinforcing of sheet and of truncated domes, integral radius cut lines on back face of tile; with factory applied removable protective sheeting.
  1. Pattern: In-line pattern of truncated domes complying with ADA Standards.
  2. Color: As selected by Architect from manufacturer's standard range.
  3. Color: SAE AMS-STD-595, Table IV, Federal Yellow No. 33538.
  4. Products:

### PART 3 EXECUTION

#### 3.01 INSTALLATION, GENERAL

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- 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.
- C. Install units fully seated to substrate, square to straight edges and flat to required slope.

**END OF SECTION 32 1726**

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## SECTION 32 3001 SITE FURNISHINGS

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. Trash / Recycling Receptacles.
- B. Drinking Fountains.

#### 1.02 SUBMITTALS

- A. Product Data: For each type of product indicated. Refer to Site Furnishings Legend on Sheet L0.1.
- B. Samples: For each exposed finish.
- C. Material Certificates: For site furnishings, signed by manufacturers.
- D. Maintenance Data.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes.
- B. Steel and Iron: Free of surface blemishes.
- C. Stainless Steel: Free of surface blemishes.
- D. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials; commercial quality, tamperproof, vandal and theft resistant, concealed, recessed, and capped or plugged.
- E. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107; recommended in writing by manufacturer, for exterior applications.
- F. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.
- G. Galvanizing:
  - 1. Zinc-Coated Tubing: External, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, polymer film. Internal, same as external or consisting of 81 percent zinc pigmented coating, not less than 0.3 mil thick.
  - 2. Hot-Dip Galvanizing: According to ASTM A 123/A 123M, ASTM A 153/A 153M, or ASTM A 924/A 924M.

#### 2.02 SITE FURNISHINGS

- A. See drawings for "Site Furnishing Legend" on sheet L0.1 for additional site furnishing model numbers, including installation method and finishes.
- B. Minimum material requirements specified in this section apply to other furnishing listed on drawings not found in this section.

#### 2.03 DRINKING FOUNTAIN

- A. Basis-of-Design Product: Subject to compliance with requirements, provide HAWS; Model #3816-01, with bottle filler and hi-lo ADA stainless steel, or an equal product as approved.
- B. Materials: Heavy duty cast aluminum, matte silver powder coat finish.
- C. Components:

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1. Material:
  - a. 100% lead free wterways.
  - b. Vandal resistant polished chrome plated strainers.
  - c. Vandal resistant access plates

#### **2.04 TRASH / RECYCLING RECEPTACLES**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Landscape Forms, Model # Chase Park Side Opening, or an equal product by one of the following:
  1. Quickcrete
  2. DuMor Inc.
  3. Hess America
  4. Urban Accessories, Inc.
- B. Steel Finish: Galvanized and powder coated.
  1. Color: As selected by Architect from manufacturer's full range.

#### **2.05 FABRICATION**

- A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.
- B. Welded Connections: At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.
- C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.
- E. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION, GENERAL**

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Post Setting: Set cast-in support posts in concrete footing plumb or at correct angle and aligned and at correct height and spacing.
- C. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and fill annular space between post and concrete with nonshrink, nonmetallic grout mixed and placed to comply with anchoring material manufacturer's written instructions.
- D. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout mixed and placed to comply with anchoring material manufacturer's written instructions.
- E. Flag Pole: Provide grounding and lightning spike as recommended by manufacturer.

**END OF SECTION 32 3001**

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## SECTION 32 3113 CHAIN LINK FENCES AND GATES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Posts, rails, and frames.
- B. Wire fabric.

#### 1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete anchorage for posts.
- B. Section 33 7900 - Site Grounding.

#### 1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- C. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- E. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
- F. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
- G. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain Link Fence Fabric.
- H. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework.
- I. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
- J. ASTM F1665 - Standard Specification for Poly(Vinyl Chloride) (PVC) and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used with Chain-Link Fence.
- K. CLFMI CLF-PM0610 - Product Manual.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- C. Shop Drawings: Indicate in plan layout and elevation, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.
- D. Manufacturer's Installation Instructions: Indicate installation requirements
- E. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines.

#### 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.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. Posts, Rails, and Frames:

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- B. ASTM A1011/A1011M, Designation SS; hot-rolled steel strip, cold formed to pipe configuration, longitudinally welded construction, minimum yield strength of 50 ksi; zinc coating conforming to ASTM F1043 and ASTM F1083.
- C. Line Posts: Type I round.
- D. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round.
- E. Wire Fabric:
- F. ASTM A392 zinc coated steel chain link fabric.
- G. Conform to CLFMI CLF-PM0610.
- H. Ready-mixed, complying with ASTM C94/C94M; normal Portland cement; 3000 psi strength at 28 days, 3 inch slump; 3/4 inch nominal size aggregate.

## 2.02 COMPONENTS

- A. Line Posts: 3 inch diameter Schedule 40 Steel.
- B. Corner and Terminal Posts: 4.0 inch diameter.
- C. Gate Posts: 4 inch diameter.
- D. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.
- E. Gate Frame: 1.66 inch diameter for welded fabrication.
- F. Fabric: 2 inch diamond mesh interwoven wire, 6 gage, 0.1920 inch thick, top selvage knuckle end closed, bottom selvage twisted tight.
- G. Tension Wire: 6 gage, 0.1920 inch thick steel, single strand.
- H. Tension Band: [ ] inch thick steel.
- I. Tie Wire: Aluminum alloy steel wire.
- J. Ground fence in accordance with Section 33 7900.

## 2.03 ACCESSORIES/HARDWARE

- A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.
- C. Gates that are part of the accessible route shall meet all the requirements of an accessible door in compliance with **CBC Section 11B-404**.
- D. The lever of lever actuated latches or locks for an accessible gate shall be curved with a return to within 1/2" of the (face of) gate to prevent catching on the clothing or persons. **California Referenced Standards code. T-24 part 12, Section 12-10-202, Item (F)**.
- E. Swing doors and gate surfaces within 10" of the finish floor or ground shall have a smooth surface on the push side extending the full width of the door or gate. Parts creating horizontal or vertical joints in these surfaces shall be within 1/16" of the same plane as the other and be free of sharp or abrasive edges. Cavities created by added kick plates shall be capped. **CBC Section 11B-404.2.10**
- F. The clear opening width for a door shall be 32" minimum. For a swinging door it shall be measured between the face of the door and the stop, with the door open 90 degrees. There shall be no projections into it below 34" and 4" maximum projections into it between 34" and 80" above the finish floor or ground. Door closers and stops shall be permitted to be 78" minimum above the finish floor or ground. **CBC Section 11B-404.2.3**
- G. Handles pulls, latches, locks, and other operable parts on accessible doors shall comply with **CBC Section 11B-309.4** and shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. Operable parts of such hardware shall be 34" minimum and 44" maximum above finish floor or ground. Where sliding doors are in the fully open position, operating hardware shall be exposed and usable from both sides. **CBC Section 11B-404.2.7**

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- H. The force for pushing or pulling open a door shall be as follows: **CBC Section 11B-404.2.9**
  - 1. Interior hinged doors, sliding or folding doors: **5 pounds(22.2N)** maximum. Required fire doors: the minimum opening force allowable by the DSA authority, not to exceed **15 pounds (67N)**. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position.
  - 2. The force required for activating any operable parts, such as lever hardware, or disengaging other devices shall be 5 pounds(22.2 N)maximum to comply with CBC Section 11B-309.4
- I. Door closing speed shall be as follows: **CBC Section 11B-404.2.8**
  - 1. Closer shall be adjusted so that the required time to move a door from an open position of 90 degrees to a position of 12 degrees from the latch is **5** seconds min.
  - 2. Spring hinges shall be adjusted so that the required time to move a door from an open position of 70 degrees to the closed position is **1.5** seconds minimum.
- J. Thresholds shall comply with **CBC Section 11B-404.2.5**
- K. Floor stops shall not be located in the path of travel and 4" maximum from walls. **DSA Policy 99-08.**
- L. Hardware (including panic hardware) shall not be provided with "Night Latch" (NL) function for any accessible doors or gates unless the following conditions are met per **DSA Interpretation 10-08 DSA/AC (External), revised 4/28/09**. Such conditions must be clearly demonstrated and indicated in the specifications:
  - 1. Such hardware has a 'dogging' feature.
  - 2. It is dogged during the time the facility is open.
  - 3. Such 'dogging' operation is performed only by employees as their job function(non-public use).
- M. Pair of doors: limit swing of one leaf to 90 degrees so that a clear floor space is provided beyond the arc of the swing for the wall-mounted tactile sign. **CBC Section 11B-703.4.2.1**

## 2.04 FINISHES

- A. Components and Fabric: Vinyl coated over coating of 1.8 ounces per square foot galvanizing.
- B. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.
- C. Accessories: Same finish as framing.
- D. Color(s): Black.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ASTM F567.
- B. Place fabric on outside of posts and rails.
- C. Set intermediate posts plumb , in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
- D. Line Post Footing Depth Below Finish Grade: ASTM F 567.
- E. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F 567.
- F. Brace each gate and corner post to adjacent line post with horizontal center brace rail. Install brace rail one bay from end and gate posts.
- G. Provide top rail through line post tops and splice with 6 inch long rail sleeves.
- H. Install center brace rail on corner gate leaves.
- I. Do not stretch fabric until concrete foundation has cured 28 days.
- J. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.
- K. Position bottom of fabric 2 inches above finished grade.

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- L. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.
- M. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
- N. Install bottom tension wire stretched taut between terminal posts.
- O. Install support arms sloped inward and attach barbed wire; tension and secure.
- P. Do not attach the hinged side of gate to building wall; provide gate posts.
- Q. Install hardware and gate with fabric to match fence.
- R. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

### **3.02 TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From True Position: 1 inch.
- C. Do not infringe on adjacent property lines.

**END OF SECTION 32 3113**

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## SECTION 32 3119 TUBE STEEL FENCES AND GATES

### PART1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Tube steel fencing.
- B. Tube steel gates.
- C. Accessible gate hardware
- D. Horizontal sliding gates.

#### 1.02 RELATED REQUIREMENTS

- A. Division 03 Section Cast-in-Place Concrete Division 03 Section Cast-in-Place Concrete
- B. Division 07 Section Joint Sealants
- C. Division 08 Section Door Hardware
- D. Division 09 Section High Performance Exterior Metal Coatings
- E. Division 32 Section Architectural Site Concrete

#### 1.03 SUBMITTALS

- A. Shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.
  - 1. Prepare Project specific information, drawn accurately to scale. Shop Drawings shall not be reproductions of the Contract Documents or any standard printed data.
  - 2. Where installed metal fabrications are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis that has been signed and sealed by the qualified professional engineer who was responsible for the preparation.
- B. Product data in the form of manufacturer's technical data, specifications, and installation instructions for fence and gate posts, fabric, gates, hardware and accessories specified in the section.
  - 1. Fence and gate posts, rails, and fittings.
  - 2. Gates and hardware, including accessible gate lever lockset.
  - 3. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

#### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has at least three years' experience and has completed at least five tube steel fence projects with same material and of similar scope to that indicated for this Project with a successful construction record of in-service performance.
- B. Single-Source Responsibility: Obtain tube steel fences and gates, including accessories, fittings, and fastenings, from a single source.

#### 1.05 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for fences and gates shown on the Drawings in relation to the property survey and existing structures. Verify dimensions by field measurements.

### PART 2 PRODUCTS

#### 2.01 TUBE STEEL FENCE

Tube Steel Fences and Gates	32 3119 - 1
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- A. All parts shall be tube steel. All posts, frames, rails, and braces parts shall be tube steel meeting the requirements of ASTM A 500 grade B.787. All other tube steel shall meet the requirements of ASTM A 513. All posts shall have a welded post cap.

- 1. Sizes shall be as noted on plans and details.

- B. Infill Panels: Custom design as indicated on Drawings.

- C. Steel Finish: High-performance coating.

## 2.02 VEHICLE GATES

- A. Gates shall be located as shown on the Drawings and sized to suit existing walkways and roadways. All vehicular gates shall have a minimum clear opening of 20 feet designated for Fire Department access. Materials used shall be equal to or greater than that used in adjoining sections of fence and be compatible with the application.

- B. Steel Finish: High-performance coating.

## 2.03 PEDESTRIAN GATES

- A. Pedestrian gates shall have a ladder type frame, i.e., two vertical ends and two horizontal rails and made of steel tubing, gate pickets, provisions for locking hardware, kickplate/kickbox, drop rod and gate hardware.

- B. Frame Corner Construction: Welded with an intermediate rail for panels 5 feet (1.52 m) wide or wider.

- C. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf more than 5 feet (1.52 m) wide. Provide center gate stops and cane bolts for pairs of gates.

- D. Steel Finish: High-performance coating.

## 2.04 HARDWARE

- A. Pedestrian Gate Hardware: Provide galvanized hardware and accessories for each gate according to the following:

- B. Accessible Latch/Lockset: Locksets shall be heavy-duty with hinged, anti-friction, 1-inch throw latchbolt with anti-friction piece made of self-lubricating stainless steel. Provide locksets with interchangeable core cylinders. Provide double cylinder, keyed to match building exterior doors. Locksets to be furnished with thru-bolted hardware to attached through gate frame, round or square post stock. Lever handles must be of forged or cast brass, bronze or stainless steel construction.

- 1. Basis-of-Design Product: Schlage L9070T SPA 626 IC Core 20-740-626. For use with panic hardware use Schlage rim cylinder 20-057 ICX 626, IC Core 20-740-626.

- 2. Locksets to be furnished with thru-bolted hardware to attached through gate frame, round or square post stock. Lever handles must be of forged or cast brass, bronze or stainless steel construction

- C. Kickplate: Smooth solid metal surface (12GA), to match frame material and finish, along the entire width of the gate, and minimum of 10" above the pedestrian surface to be provide at all accessible pedestrian gates.

- D. All gate drop rod assemblies are to use a 1/2" diameter solid steel center stop. Provide a 12" steel sleeve. In asphalt areas secure sleeve in a 12" diameter by 18" deep concrete footing.

- E. All non-automated vehicular and fire lane gates shall have a hold open post. Posts shall have a provision for locking the gate to the post in the open position.

- F. Pedestrian Gate Hinges: BHMA A156.1, Grade 1, suitable for exterior use.

- 1. Function: 39 - Full surface, triple weight, antifriction bearing.

- 2. Material: Wrought steel, forged steel, cast steel, or malleable iron.

- 3. Weld surface to attach to post or jamb

- 4. Size & Quantity: 5" x 1-1/4" (3 per leaf).

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- G. Vehicular Gate Hinges:
1. Basis-of-Design Product: The design for hinging systems is based on "Guardian Series 2000" Antech Corporation 3431 East Lind Road, Tucson, AZ 85716, (800) 866-9115, or a comparable product.
  2. Weld surface to attach to post or jamb
  3. Roller bearing design.
  4. Zerk fitting for greasing.
  5. 3/4"-inch gap when gate is opened 90 degrees.
  6. Stainless steel washes and Zinc Plated bolt.
  7. Size & Quantity: 4-inch by 2-inch. One pair per 1500 lbs. (3 minimum per leaf)
- H. Exit Hardware: BHMA A156.3, Grade 1, Type 1 (rim exit device), with push pad actuating bar, suitable for exterior use.
1. Basis of Design: Duprin 98L, 630 finish with rim cylinder.
  2. Function: 04 - Entrance by trim when latch bolt is released by key or set in a retracted position by key.
  3. Mounting Channel: Bent-plate channel formed from 1/8-inch- (3.2-mm-) thick, steel plate. Channel spans gate frame. Exit device is mounted on channel web, recessed between flanges, with flanges extending 1/8 inch (3.2 mm) beyond push pad surface.
- I. Cane Bolts: Provide for inactive leaf of pairs of gates. Fabricated from 1/2-inch- (12.7 -mm-) diameter, round steel bars, hot-dip galvanized after fabrication, unless otherwise shown on drawings. Finish to match gates. Provide galvanized-steel pipe strikes to receive cane bolts in both open and closed positions.
- J. Gate Keeper: Galvanized steel, duckbill type to auto-engage in open position and hold open. High Performance coating to match fence and gate color.
- K. Gates that are part of the accessible route shall meet all the requirements of an accessible door in compliance with **CBC Section 11B-404**.
- L. The lever of lever actuated latches or locks for an accessible gate shall be curved with a return to within 1/2" of the (face of) gate to prevent catching on the clothing or persons. **California Referenced Standards code. T-24 part 12, Section 12-10-202, Item (F)**.
- M. Swing doors and gate surfaces within 10" of the finish floor or ground shall have a smooth surface on the push side extending the full width of the door or gate. Parts creating horizontal or vertical joints in these surfaces shall be within 1/16" of the same plane as the other and be free of sharp or abrasive edges. Cavities created by added kick plates shall be capped. **CBC Section 11B-404.2.10**
- N. The clear opening width for a door shall be 32" minimum. For a swinging doors it shall be measured between the face of the door and the stop, with the door open 90 degrees. There shall be no projections into it below 34" and 4" maximum projections into it between 34" and 80" above the finish floor or ground. Door closers and stops shall be permitted to be 78" minimum above the finish floor or ground. **CBC Section 11B-404.2.3**
- O. Handles pulls, latches, locks, and other operable parts on accessible doors shall comply with **CBC Section 11B-309.4** and shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. Operable parts of such hardware shall be 34" minimum and 44" maximum above finish floor or ground. Where sliding doors are in the fully open position, operating hardware shall be exposed and usable from both sides. **CBC Section 11B-404.2.7**
- P. The force for pushing or pulling open a door shall be as follows: **CBC Section 11B-404.2.9**
1. Interior hinged doors, sliding or folding doors: **5 pounds(22.2N)** maximum. Required fire doors: the minimum opening force allowable by the DSA authority, not to exceed **15 pounds (67N)**. These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position.

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2. The force required for activating any operable parts, such as lever hardware, or disengaging other devices shall be 5 pounds(22.2 N)maximum to comply with CBC Section 11B-309.4
- Q. Door closing speed shall be as follows: **CBC Section 11B-404.2.8**
1. Closer shall be adjusted so that the required time to move a door from an open position of 90 degrees to a position of 12 degrees from the latch is **5** seconds min.
  2. Spring hinges shall be adjusted so that the required time to move a door from an open position of 70 degrees to the closed position is **1.5** seconds minimum.
- R. Thresholds shall comply with **CBC Section 11B-404.2.5**
- S. Floor stops shall not be located in the path of travel and 4" maximum from walls.
- T. Hardware (including panic hardware) shall not be provided with "Night Latch" (NL) function for any accessible doors or gates unless the following conditions are met per **DSA Interpretation 10-08 DSA/AC (External), revised 4/28/09**. Such conditions must be clearly demonstrated and indicated in the specifications:
1. Such hardware has a 'dogging' feature.
  2. It is dogged during the time the facility is open.
  3. Such 'dogging' operation is performed only by employees as their job function(non-public use).
- U. Pair of doors: limit swing of one leaf to 90 degrees so that a clear floor space is provided beyond the arc of the swing for the wall-mounted tactile sign. **CBC Section 11B-703.4.2.1**

## 2.05 HORIZONTAL SLIDE GATES

- A. Gate Configuration: Single leaf.
1. Type: Cantilever slide, with external roller assemblies.
- B. Gate Frame Height: 72 inches (1830 mm).
- C. Gate Opening Width: As indicated on drawings.
1. Steel Frames and Bracing: Fabricate members from square tubing. [Hot-dip galvanized frames after fabrication.]
    - a. Frame Members: Steel tubing 2 by 4 inches (50 by 100 mm)] with 1/8-inch (3.2-mm) wall thickness.
    - b. Bracing Members: Steel tubing 2 by 2 inches (50 by 50 mm) with 1/8-inch (3.2-mm) wall thickness.
- D. Frame Corner Construction:
1. Welded frame with panels assembled with bolted corner fittings.
- E. Additional Rails: Provide as indicated, complying with requirements for fence rails.
- F. Infill: Comply with requirements for adjacent fence.
- G. Picket Size, Configuration, and Spacing: Comply with requirements for adjacent fence.
1. Treillage: Provide iron castings of pattern indicated between each pair of pickets. Finish as specified for adjacent fence.
- H. Hardware: Latches permitting operation from both sides of gate, hangers, roller assemblies, and stops fabricated from galvanized steel.
- I. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.
- J. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A 123/A 123M unless otherwise indicated. For hardware items, hot-dip galvanize to comply with ASTM A 153/A 153M.
- K. Steel Finish: High-performance coating.

## 2.06 FINISHES

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- A. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.
- B. Surface Preparation: Clean surfaces according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 1. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- C. Primer Application: Apply zinc-rich epoxy primer immediately after cleaning, to provide a minimum dry film thickness of 2 mils (0.05 mm) per applied coat, to surfaces that will be exposed after assembly and installation, and to concealed surfaces.
- D. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
  - 1. Match approved Samples for color, texture, and coverage. Remove and refinish, or recoat work that does not comply with specified requirements.
- E. Powder Coating: Immediately after cleaning, apply 2-coat finish consisting of epoxy primer and TGIC polyester topcoat, with a minimum total dry film thickness of not less than 8 mils (0.20 mm). Comply with coating manufacturer's written instructions.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

## **2.07 MISCELLANEOUS MATERIALS**

- A. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Division 3 Section "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi (20 MPa), 3-inch (75-mm) slump, and 1-inch (25-mm) maximum aggregate size or dry, packaged, normal-weight concrete mix complying with ASTM C 387 mixed with potable water according to manufacturer's written instructions.
- B. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107 and specifically recommended by manufacturer for exterior applications.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance.
  - 1. Do not begin installation before final grading is completed, unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 PREPARATION**

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 200 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, property monuments, property lines, and easements.

### **3.03 PERFORMANCE REQUIREMENTS**

- A. All gates shall be designed and constructed to withstand the weight of a 200 pound person standing at the mid-point on the lower rail without permanent deformation of any component members of the assembly.
- B. Fabricator to provide structural calculations for each type gate verifying the performance requirements of this section.

### **3.04 ON THE JOB SITE**

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- A. After the fence has been erected and is mechanically complete, wire brush field welds, dry wipe off all loose residue, spot prime with the Zinc Chromate all bare metal, bare spots and chips, and unpainted surfaces. Then spray a finish coat over the entire fence installation with one coat of industrial quality coating. Care shall be taken to keep paint off of sidewalks, wall, etc.

### 3.05 FABRICATION AND INSTALLATION

- A. Fencing shall be welded and have smoothed, clean, slag free welds. Dimensions and installation shall be in accordance with the drawings.
- B. The lever of lever actuated latches or locks for an accessible gate shall be curved with a return to within 1/2" of the (face of) gate to prevent catching on the clothing or persons. **California Referenced Standards code. T-24 part 12, Section 12-10-202, Item (F).**
- C. Swing doors and gate surfaces within 10" of the finish floor or ground shall have a smooth surface on the push side extending the full width of the door or gate. Parts creating horizontal or vertical joints in these surfaces shall be within 1/16" of the same plane as the other and be free of sharp or abrasive edges. Cavities created by added kick plates shall be capped. **CBC Section 11B-404.2.10**

### 3.06 POST SETTING

- A. General: Comply with ACI 301 for cast-in-place concrete.
- B. Materials: Portland cement complying with ASTM C 150, aggregates complying with ASTM C 33, and potable water for ready-mixed concrete complying with ASTM C 94.
  - 1. Concrete Mixes: Normal-weight concrete with not less than 3000-psi (20.7- MPa) compressive strength (28 days), 3-inch (75-mm) slump, and 1-inch (25-mm) maximum size aggregate.
- C. All posts to be set in concrete as detailed on the drawings.
- D. All posts to have concrete domed to shed water. All posts to be set to a maximum of 8 feet O.C. All post to be set plumb, in line, and to correct height. A Corner Post is required when line of fence direction changes 30 degrees or more.
- E. All posts set in existing concrete slabs to be set in a 6 inch core drilled hole and set to a depth of 24 inches. All 6 inch gate posts set in existing concrete slabs are to be set in 12 inch square saw cut to a depth of 43 inches.

### 3.07 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by the manufacturer in writing for exterior applications.

### 3.08 GATE INSTALLATION

- A. General: Install gates level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

### 3.09 SITE CLEAN UP

- A. The construction site shall be cleaned up and all accumulated debris removed by the Contractor.

**END OF SECTION 32 3119**

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## SECTION 32 3300 ARCHITECTURAL SITE CONCRETE

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. Concrete site walls.
- B. Concrete retaining walls.(48" or less in height)
- C. Concrete planters.
- D. Skateboard deterrents.
- E. Light pole bases.
- F. Other architectural site concrete as indicated.

#### 1.02 RELATED REQUIREMENTS

- A. Division 07 Section - Joint Sealants
- B. Division 09 Section - Permanent Non-Sacrificial Anti-Graffiti
- C. Division 32 Section - Concrete Paving
- D. Division 32 Section - Concrete Paving Joint Sealants

#### 1.03 DEFINITIONS

- A. Cast-in-Place Architectural Site Concrete: Non-building formed concrete that is exposed to view in completed exterior work and that requires concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.
- B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: Fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
- C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural site concrete.
- D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

#### 1.04 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at project site.
  - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place architectural site concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. District's Representative(s).
    - d. Ready-mix concrete manufacturer.
    - e. Architect's Representative(s)
    - f. Cast-in-place architectural site concrete subcontractor.
    - g. Inspector of Record (IOR).
    - h. Subcontractor for any adjacent work
  - 2. Review testing and inspection procedures, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, concrete repair procedures, and protection of cast-in-place architectural site concrete.
  - 3. Contractor to provide meeting minutes for pre-installation conference.

#### 1.05 SUBMITTALS

- A. Product Data: For each type of product.

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1. Proprietary admixtures, pigments, curing compounds, hardeners, sealers, form-release agents, all accessory material, etc.: Indicate compatibility with other materials used.
- B. Samples for Initial Selection: For each type of product, ingredient or admixture requiring color selection.
  1. Submit manufacturer selected range of colors and products for review.
  2. Provide custom colors or samples as required.
  3. Upon selection of color submit 12"X12" sample of material in the specified color/finish for review by the Landscape Architect in addition to the specified mock-ups.
- C. LEED Submittals:
  1. Product Data for Credit MR 4.1 [and Credit MR 4.2]: For products having recycled content, documentation indicating percentages by weight of post-consumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
  2. Design Mixtures for Credit ID 1.1: For each concrete mixture containing at least 40% fly ash as a replacement for Portland cement or other Portland cement replacements and for equivalent concrete mixtures that do not contain Portland cement replacements.
- D. Design Mixtures: Submit proposed mix designs and test data for each class, color, application, and strength of concrete and for each method of placement.
  1. Prepare mix designs on the basis of field experience (preferred) and/or trial mixes, in compliance with California Building Code (CBC), Section 1905A.3.
  2. Prepare mix designs on the basis of field experience (preferred) and/or trial mixes, in compliance with California Building Code (CBC), Section 1905.3.
  3. Mix designs shall be prepared and signed by a structural or civil engineer registered in the State of California.
    - a. Mix designs shall be reviewed by the Architect and Structural Engineer of Record (SEOR).
  4. Identify for each mix design submitted the method by which proportions have been selected.
    - a. For mix designs based on field experience, include individual strength test results, standard deviation, and required average compressive strength calculations.
    - b. For mix designs based on trial mixtures, include trial mix proportions, test results, graphical analysis and show required average compressive strength face results. Provide gross weight and yield per cubic yard of trial mixes.
    - c. Indicate quantity of each ingredient per cubic yard of concrete.
    - d. Indicate type and quantity of admixtures proposed or required.
    - e. Indicate water to cement ratio by weight.
    - f. Measured slump.
    - g. Measured air content.
    - h. Provide shrinkage test results.
    - i. Provide maximum [5%] fly ash; ground granulated blast-furnace slag, and/or silica fume content as Portland cement replacement in all concrete.
    - j. No fly ash will be permitted
  5. Submit proposed alternate design mixtures for review by the Architect and SEOR(Structural Engineer of Record) when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
  6. Mix designs for each application must be from a single source for the duration of the project. Multiple vendors or courses will not be permitted.
  7. All mix designs must be wet stamped by a licensed Engineer.
- E. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
  1. Coordinate with and identify the details of the Contract Drawings on the shop drawings.

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2. Comply with ACI 315, part B and CRSI requirements.
- F. Formwork Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural site concrete.
  1. Engineering Responsibility: Formwork shop drawings shall be prepared by or under the supervision of a licensed professional engineer detailing fabrication, assembly, and support of formwork.
  2. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
  3. Location of form ties and patterns are subject to approval of the Landscape Architect. For walls less than 18" high, ties to be located above and below wall face, whenever possible.
  4. Align all form joints with reveal locations indicated on plans. Provide custom size and cut form boards as required.
- G. Construction Joint Layout: Indicate proposed construction joints required to construct the structure. Submit dimensioned drawing indicating layout of construction joints, contraction (control) joints, dowelled joints, decorative scoring and placement sequence of concrete.
  1. Location of construction joints are subject to approval of the Architect.
  2. Construction joints locations should align with reveal locations as located per drawings.
  3. Provide custom form boards as required for joint alignment noted per drawings.
  4. Align all form joints with reveal locations indicated on plans. Provide custom size and cut form boards as required.
- H. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.
- I. Samples: For each of the following materials:
  1. Form-facing panel.
  2. Form ties.
  3. Form liners.
  4. Coarse- and fine-aggregate gradations.
  5. Chamfers and rustications.
  6. Reveals
  7. One quart sample of sand and fine aggregate
  8. On quart sample of coarse aggregate
- J. Qualification Data: For manufacturer (batch plant).
- K. Welding Certificates: Submit certifications signed by AWS Certified Welding Inspector of prequalified welding procedures, qualifications of welding procedures unless prequalified, qualifications of welding operators and qualifications of welders.
- L. Material Certificates: For each of the following:
  1. Cementations materials.
  2. Aggregates and sand.
  3. Admixtures.
  4. Form materials and form-release agents.
  5. Steel reinforcement and accessories.
    - a. Provide mill test certificates for all reinforcing steel, showing physical and chemical analyses. For steel that will be welded, include in the chemical analysis the percentages of carbon, manganese, copper, nickel, chromium, phosphorus and sulfur, and optionally, the percentages of molybdenum and vanadium.
  6. Curing compounds.
  7. Surface treatments.
  8. Bonding agents.
  9. Adhesives.
  10. Semi rigid joint filler.

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11. Joint-filler strips.
12. Repair materials.
- M. Material Test Reports: For the following, by a qualified testing agency:
  1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- N. Field Quality-control Reports. Submit reports of all compressive strength, slump, shrinkage and air content tests required by the authorities having jurisdiction and as indicated.
  1. Submit copies of delivery tickets complying with ASTM C 94 for each load of concrete delivered to the site. Tickets shall include all information required by the referenced standard.
- O. Minutes of pre-installation conference.

## 1.06 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with CBC Chapter 19A.
  1. Chemical products field-applied to concrete shall comply with the air quality requirements of authorities having jurisdiction.
- B. Industry Standards: Comply with the following unless modified by requirements in the Contract Documents.
  1. ACI 301, "Specifications for Structural Concrete".
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials".
  3. ACI 302.1R, "Guide for Concrete Floor and Slab Construction".
  4. ACI 303.1 "Specifications for Cast-in-Place Architectural Concrete".
  5. ACI 304R, "Guide for Measuring, Mixing, Transporting, and Placing Concrete".
  6. ACI 305R, "Hot Weather Concreting".
  7. ACI 306.1, "Standard Specification for Cold Weather Concreting".
  8. ACI 318, "Building Code Requirements for Structural Concrete".
  9. ACI 347, "Guide to Formwork for Concrete".
  10. ACI 318, "Building Code Requirements for Structural Concrete."
  11. ACI SP-66, "ACI Detailing Manual".
  12. CRSI, "Manual of Standard Practice".
  13. CRSI, "Placing Reinforcing Bars".
- C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  1. Manufacturer certified according to NRMCA's "NRMCA Quality Control Manual - Section 3, Certification of Ready Mixed Concrete Production Facilities."
  2. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
  3. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
  4. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations for Cast-in-Place Architectural Site Concrete: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide cast-in-place architectural site concrete of consistent quality in appearance and physical properties for the duration of the project.
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  1. ACI 301, "Specification for Structural Concrete,"[Sections 1 through 5.] [Sections 1 through 5 and Section 6, "Architectural Concrete."]

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2. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete."
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- G. Source Limitations for Concrete Paving: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties. Secure all material required for the duration of the project as needed to ensure consistent quality in appearance
- H. Welding Qualifications: Comply with CBC Chapter 17A.
  1. Qualify welding procedures and welding personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel" prior to performing any welding.
  2. Qualify welding inspection personnel according to AWS QC1, "Standard for AWS Certification of Welding Inspectors."
- I. Welding Qualifications: Comply with CBC Chapter 17.
  1. Qualify welding procedures and welding personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel" prior to performing any welding.
  2. Qualify welding inspection personnel according to AWS QC1, "Standard for AWS Certification of Welding Inspectors."
- J. Mockups: Before casting architectural site concrete, build mockups to verify selections made under Sample submittals and to fully demonstrate typical joints, surface finish, texture, tolerances, reveals edges, bulkhead or cold joints, standard of workmanship and completed product. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
  1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
  2. Build mockups full-size, matching architectural site concrete components indicated on the Drawings. Mock-ups shall be complete in every detail, including joints, reveals, chamfers, etc. Include complex joinery conditions where necessary to integrate to other Project components as indicated.
  3. Maintain accurate records of variables associated with each mockup to facilitate the matching of accepted mockups during actual construction.
  4. Demonstrate curing, cleaning, and protecting of cast-in-place architectural site concrete, finishes, and contraction and expansion joints, as applicable.
  5. Required Mock-up Types:
    - a. Walls: Construct at least 6 linear feet by 4 foot height of finished concrete site walls for each color, finish, and mix design. Thickness of walls as noted on plans.
    - b. Benches and Seats: Construct at least 6 linear feet of finished concrete site benches and seats.
    - c. Planters: Construct at least 6 linear feet of finished concrete site planters.
    - d. Repairs: In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes, honeycombing, spalls, surface blemishes, etc. to match adjacent undamaged surfaces.
  6. Mock-up Acceptance: Obtain Architect's approval of mockups before casting architectural site concrete.
    - a. The mock-up acceptance shall be judged between a distance of 5 feet to 10 feet, at the Architects discretion.
    - b. The Architect may reject mockups that, in the Architect's sole judgment, do not demonstrate an acceptable completed product, including, but not limited to, color, joint work, surface finish, texture, tolerances, and standard of workmanship
    - c. The Architect may require modifications to mockups to obtain acceptable results.
    - d. The Architect may require modifications to mockup repairs to obtain acceptable results.

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- e. The Architect may require removal and reconstruction of mockups to obtain acceptable results. Multiple mock ups may be required.
- f. Contractor shall provide additional mockups as required to obtain results acceptable to the Architect at no additional cost to the Owner.
- 7. Mockup Disposition: Accepted mockups shall not become part of the completed Project. Maintain mock-up on-site for the duration of construction and until all work has been accepted. Remove and legally dispose mockups after acceptance of final installed work. If sufficient permanent architectural site work has been completed, Contractor may submit a written request to Architect to transfer quality control for architectural site concrete from the accepted mockups to one or more designated portions of the permanent work.

#### **1.07 PROJECT CONDITIONS:**

- A. Traffic Control: Maintain access for Owner's operations and for vehicular and pedestrian control required for construction activities.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
  - 1. Label bundles with durable identification tags. Maintain reinforcement identification after bundles are broken.
  - 2. Store reinforcement to avoid excessive rusting or fouling with grease, oil, dirt or other bond-weakening contaminants.
  - 3. Avoid damaging applied coatings, if any, on steel reinforcement.

### **PART 2 - PRODUCTS**

#### **2.01 FORM-FACING MATERIALS**

- A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for formwork and other form-facing material requirements.
- B. Form-Facing Panels for As-Cast or Exposed-Aggregate Finishes: Steel, glass-fiber-reinforced plastic, or other approved non-absorptive panel materials that will provide continuous, true, and smooth architectural site concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- C. Form-Facing Panels for all exposed As-Cast and Exposed-Aggregate Concrete Finishes: Provide steel, glass-fiber-reinforced plastic, or overlain exterior-grade plywood panels, non-absorptive, that will provide continuous, true, and smooth architectural site concrete surfaces, with no wood grain, honeycombing or patch transfer.
  - 1. Faced plywood panels shall comply with, or be equivalent to, DOC PS 1, Structural I. Provide minimum 7-ply plywood and provide balance sheets for panels coated one-side only. Furnish in largest practicable sizes to minimize number of joints.
    - a. Smooth As-Cast Finish: High-Density Overlay (HDO). Provide one of the following panels, or comparable substituted product:
      - 1) Olympic Panel Products, "Multipour Concrete Form." Overlay Color: Buff.
      - 2) Pacific Laminate Products, "ProFace HDO." Overlay Color: White.
      - 3) Sylvan Products, LLC, "Armor Ply HDO" Overlay Color: Buff.
    - b. Retarder As-Cast Finish: Medium-Density Overlay (MDO), with mill-applied release agent and edge sealant. Provide one of the following panels, or comparable substituted product:
      - 1) Olympic Panel Products, "B-Matte 333 MDO Concrete Form." Overlay Color: Brown.
      - 2) Pacific Laminate Products, "ProFace MDO." Overlay Color: Black.
      - 3) Sylvan Products, LLC, "Armor Ply MDO" Overlay Color: Brown.
  - 2. Curved Work: Kerf back of plywood form-facing panels, or use accepted flexible or curved forms for curved work with a radius of 100 feet or less to match finish provided by form material noted in items 1 and 2 above.

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- D. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will provide surfaces without gradual or abrupt irregularities that exceed specified formwork surface class.
  - 1. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
  - 2. Finished work is to be free of seams or form markings.
- E. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- F. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.
- G. Rustication Strips or Reveals: Wood, metal or rigid plastic, with sides beveled and back kerfed; nonstaining; in longest practicable lengths. Align reveals as shown on plans and with form seams.
- H. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum 1/4 inch (6 mm) thick.
- I. Form Joint Sealant: Urethane or silicone elastomeric sealant complying with ASTM C 920, Type M or Type S, Grade NS that adheres to form joint substrates. Form joint sealant shall be compatible with form-facing panels.
- J. Form Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood. Form sealer shall be compatible with form-facing panels. All seams and joints are to be sealed.
- K. Form-Release Agent: Commercially formulated, colorless form-release agent that will not bond with, stain, or adversely affect architectural site concrete surfaces and will not impair subsequent treatments of those surfaces. Form-release agent shall be compatible with form-facing panels.
  - 1. Obtain written acceptance of form release agent from integral colored concrete pigment manufacturer.
  - 2. Form-release agents shall be non-staining.
  - 3. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- L. Surface Retarder (In Form): Chemical liquid set retarder, for application on form-facing materials, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.
  - 1. Provide GCP Applied Technologies Pieri "Euro-Tard" or accepted comparable substitute.
- M. Surface Retarder (Top Surface): Chemical liquid set retarder, for application on top surface of formed applications to match finish at formed faces, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.
  - 1. Provide W. R. Grace "Top-Cast" or accepted comparable substitute.
- N. Form Ties: Factory-fabricated, stainless steel or fiberglass color keyed to wall color snap ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish ties with tapered plastic tie cone spreaders that, when removed, will leave holes 3/4 inch in diameter on concrete surface.
  - 2. Furnish internally disconnecting ties that will leave no metal closer than 1-1/2 inches (38 mm) after exposing aggregate, from the architectural site concrete surface.
  - 3. Furnish glass-fiber-reinforced plastic ties, not less than 1/2 inch (13 mm) in diameter, of color selected by Architect from manufacturer's full range.
  - 4. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

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- O. Provide new forms specifically purchased for this project. Reuse of forms from past projects or contractors stock will not be accepted.
- P. Provide custom form boards as required to align seams with reveals indicated on plans.

## 2.02 STEEL REINFORCEMENT AND ACCESSORIES

- A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 60 percent.
- C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed, unless otherwise indicated.
- D. Low-Alloy-Steel Reinforcing Bars (for Welding): ASTM A 706/A 706M, Grade 60, deformed, unless otherwise indicated.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufacture according to CRSI's "Manual of Standard Practice."
  - 1. Where legs of wire bar supports contact forms, use CRSI Class 2, stainless-steel bar supports.
- F. Tie Wire: Minimum 16 ga. annealed wire, black, galvanized or coated finish to match rebar.

## 2.03 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C 150, Type II, or Type IV, gray, unless white cement is required to achieve colors indicated. Supplement with the following:
    - a. Fly Ash: ASTM C 618, Class F.
  - 2. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or Grade 120.
  - 3. Silica Fume: ASTM C 1240, amorphous silica.
    - a. Blended Hydraulic Cement: ASTM C 595, [Type IS, portland blast-furnace slag] [Type IP, portland-pozzolan] [Type I (PM), pozzolan-modified portland] [Type I (SM), slag-modified portland] cement.
- B. Normal-Weight Aggregates: ASTM C 33, [Class 5S] [Class 5M] [Class 1N] coarse aggregate or better, graded. Provide aggregates from single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials].
- C. Normal-Weight Aggregates: ASTM C 33, complying with building code. Provide aggregates from a single source. All aggregates shall be free of materials with deleterious reactivity to alkali in cement when tested in accordance with ASTM C 289.
  - 1. Comply with CBC section 1903A.3.
  - 2. Comply with CBC section 1903.3.
    - a. Service Class, based on CBC Figure 1904A.2.2, "Weathering Probability Map":
      - b. Severe and Moderate: Class 5S.
      - c. Negligible: Class 2N.
  - 3. Maximum Coarse-Aggregate Size: [3/8] [1/2][3/4] inch nominal. Maximum size shall also not be larger than 1/4 of the narrowest dimension between forms, 1/3 the depth of slab nor more than 3/4 of the minimum clear spacing between individual reinforcing bars.
    - a. Gradation: Uniformly graded.
    - b. Source: Reliance, San Gabriel, or Carrol Canyon
- D. Normal-Weight Fine Aggregate: ASTM C 33 or ASTM C 144, manufactured or natural sand, from same source for Project, free of materials with deleterious reactivity to alkali in cement and free of materials which may cause staining and light in color
  - 1. Source: Reliance, Fosters or Corona.
  - 2. Color to be white to light with no dark material.

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- E. Water: Potable, complying with ASTM C 94/C 94M except free of wash water from mixer washout operations.

## 2.04 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- C. Shrinkage-Reducing Admixture: Commercially formulated, shrinkage inhibitor capable of reducing initial shrinkage by 80% and long-term shrinkage by 50%. Provide product suitable for use with either air-entrained or non-air-entrained concrete as appropriate to structural member and project location.
1. Products: Subject to compliance with requirements, provide one of the following(as required):
    - a. Euclid Chemical Company (The), an RPM company; EUCON SRA, SRA+.
    - b. Grace Construction Products, W. R. Grace & Co.; Eclipse Floor, Eclipse Plus.
    - c. Sika Corporation; Control 40.
- D. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Davis Colors.
    - b. L.M. Scofield Company.
    - c. Solomon Colors.
  2. Color: As specified on approved plans. Selected by Architect from manufacturer's full range.

## 2.05 FIBER REINFORCEMENT

- A. Synthetic Micro-Fiber: Monofilament polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, 3/4 inches (19 mm) long.
1. Products: Subject to compliance with requirements, provide one of the following:
  2. Monofilament Micro-Fibers:
    - a. Euclid Chemical Company (The), an RPM company; Fiberstrand 150.
    - b. FORTA Corporation; FORTA Mighty-Mono.
    - c. Grace Construction Products, W. R. Grace & Co.; Grace MicroFiber.
    - d. Sika Corporation; Sika Fiber PPM.

## 2.06 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz. /sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Clear, Waterborne (Non-Colored Concrete): Provide products complying with ASTM C 309, Type 1, Class B, 18 to 25 percent solids, certified by curing compound manufacturer to not interfere with bonding of sealers, with no glossy finish and compatible with specified sealer. Provide products with not more than 100g/L volatile organic content.
1. Products: Subject to compliance with requirements.

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- D. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
  - 1. For integrally colored concrete, curing compound shall be approved by color pigment manufacturer.
  - 2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

## **2.07 SEALERS AND WATER REPELLENTS**

- A. Penetrating Liquid Floor and Horizontal Surface Treatment (Sealer): Clear, chemically reactive, water-based lithium quartz water-based lithium materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces. Materials shall be compatible with concrete admixtures and shall be recommended by manufacturer for intended use. Provide products with 0g/L volatile organic content.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Sinak Corporation; Concrete Sealer HLQ 125.
- B. Penetrating Liquid Wall and Vertical Surface Treatment (Repellent): Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces. Materials shall be compatible with concrete admixtures and shall be recommended by manufacturer for intended use. Provide products with less than 100g/L volatile organic content.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. L&M Construction Chemicals, Inc.; Hydropel WB
    - b. ProSoCo Inc.; SL100 Water Repellent
    - c. Rainguard International; Microseal(For use with VandIGuardTEN Anti-graffiti coating)

## **2.08 ANTI-GRAFFITI COATING**

- A. Refer to Section 099620 Permanent Non-Sacrificial Anti-Graffiti Coating for product and specific sealer.
  - 1. Compatible sealer to be applied prior to use of Anti-graffiti coating.

## **2.09 JOINT DEVICES, FILLER MATERIALS AND OTHER ACCESSORY PRODUCTS**

- A. Joint Filler at Exterior Sealed Joints: ASTM D 1751
  - 1. 1/4" asphalt-saturated cellulosic fiber.
  - 2. Lightweight, nonstaining, polyethylene closed cell expansion joint filler
    - a. Deck-O-Foam as manufactured by W.R.Meadows, Hampshire, Ill.
  - 3. Exterior Expansion- and Isolation-Joint-Filler Strips: See Division 32 Section "Concrete Paving Joint Sealants" for sealants for exterior joints at concrete pavements.

## **2.10 REPAIR MATERIALS**

- A. General: Provide cementitious materials, coarse aggregates, fine aggregates, water, bonding agents and admixtures as required to prepare repair grouts that will match as-cast and site finished architectural site concrete.
  - 1. Maintain accurate records of repair materials and mixtures used on accepted mockups.
- B. Bonding Agent: ASTM C 1059, Type II, non-re-emulsifiable. Provide proprietary products composed of latex polymers.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. W.R. Meadows, Inc.; Acry-Lok.
    - b. Grace Construction Products, W. R. Grace & Co.; "Daraweld C".
    - c. Larsen Products Corp., "Weld-Crete".
  - 2. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.
  - 3. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete and for anchoring dowels to hardened concrete.

## **2.11 SKATEBOARD DETERRENTS**

- A. General: Provide the following skateboard deterrents, unless otherwise indicated.

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1. Basis of Design Product: Subject to compliance with the requirements, provide the following, or comparable substituted product:
  - a. Intelliccept, Inc., "Skatestoppers FA-FR series," extruded T-6061 aluminum alloy, mill finish, model as required to match formed edge.
    - 1) [Model FA 135, to match 3/4" chamfered edge.]
    - 2) [Model FR 0.12 to match 1/8" radiused edge]

## 2.12 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of cast-in-place architectural site concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301.
  1. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.
  2. Proportioning:
    - a. The proportioning of ingredients shall be such that the concrete can be readily worked into forms and around reinforcement under the conditions of placement to be used, without segregation or excessive bleeding.
    - b. When proportioning by weight of loose, dry material, 94 pounds of cement shall be considered 1 cubic foot.
    - c. Fine aggregate volume shall be at least 35 percent, with a maximum of 50 percent, of the sum of the separate fine and coarse aggregate volumes.
    - d. Total water content shall not exceed 35 gallons per cubic yard of concrete.
    - e. Weighing equipment shall be accurate within 1 pound and shall be adjustable for varying aggregate moisture content.
    - f. A beam auxiliary shall register any part of the last 100 pounds of each aggregate. The aggregate hopper shall have a volume adjustment.
  3. Prepare compressive strength data for both 7-day and 28-day strengths.
    - a. The 7-day compressive strength shall be at least 60 percent of the required 28-day strength.
    - b. The 28-day compressive strength shall be as indicated.
  4. Provide drying shrinkage test data at 28 days, from not less than 3 test specimens.
- B. Cementitious Materials-General: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by not more than 5 percent. Per ACI 301 limits for concrete exposed to de-icing chemicals, limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
  1. Cementitious Materials-LEED Supplemental: For LEED-NC Credit ID 1.1: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by not less than 40 percent. Per ACI 301 limits for concrete exposed to de-icing chemicals, limit percentage, by weight, of cementitious materials other than Portland cement in concrete as indicated above.
  2. Fly Ash: 0-5 percent.
  3. Combined Fly Ash and Pozzolan: 0-5 percent.
  4. Ground Granulated Blast-Furnace Slag: 0-5 percent.
  5. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent Portland cement minimum, with fly ash or pozzolan not exceeding 0-5 percent.
  6. Silica Fume: 0-5 percent.
  7. Combined Fly Ash, Pozzolans, and Silica Fume: 0-5 percent with fly ash or pozzolans not exceeding 0-5 percent and silica fume not exceeding 5 percent.
- C. Proportion concrete mixtures as follows:
  1. Minimum Compressive Strength (28 Days): 3000 psi.
    - a. Provide the following minimum compressive strength (28 days) where required by high-pressure water or bush hammer finishing techniques: 4500 psi.
  2. Maximum Water-Cementitious Materials Ratio: 0.50-0.60.

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3. Slump Limit: 4 inches, plus or minus 1 inch, unless indicated otherwise.
  4. Slump Limit (High-Range Water-reducing Admixture): 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture, plus or minus 1 inch, unless indicated otherwise.
  5. Slump Limit (Plasticizing Admixture): 8 inches for concrete with verified slump of 2 to 4 inches before adding plasticizing admixture, plus or minus 1 inch, if required/unless indicated otherwise.
- D. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb./cu. yd. (0.60 kg/cu. m), unless indicated otherwise.
- E. Air Content, Exterior Exposed Concrete: Provide the following air entrainment for all exposed concrete with a weathering probability of severe or moderate per CBC figure 1904.2.2/1904A.2.2.
1. Provide air entrainment of 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size, unless indicated otherwise.
  2. Provide air entrainment of 6.0 percent, plus or minus 1.5 percent at point of delivery for 1-inch and 3/4-inch nominal maximum aggregate size, unless indicated otherwise.
- F. Slump Limit: [4 inches (100 mm)] [8 inches (200 mm)] for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm), unless otherwise indicated.
- G. Cementitious Materials: For cast-in-place architectural site concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 requirements.[ Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.]
1. Limit water-soluble, chloride-ion content in hardened concrete to [0.06] [0.15] [0.30] [1.00] percent by weight of cement.
- H. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement. Limit total chloride-ion content in hardened concrete to 0.10 percent by weight of concrete when tested per AASHTO T 260 potentiometric titration.
  2. Limit "drying shrinkage" after 28 days of curing hardened concrete to 0.045 percent of the original concrete volume.
  3. Admixtures: Admixtures may only be used if they are incorporated into the accepted concrete mix designs. Use admixtures according to manufacturer's written instructions.
    - a. Use [water-reducing] [high-range water-reducing] [or] [plasticizing] admixture in concrete, as required, for placement and workability.
    - b. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
    - c. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
    - d. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- I. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with accepted mockup.

## 2.13 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."
1. Splices: Do not splice bars, unless indicated on the Drawings.
  2. Staggered Splices: Stagger splices such that not more than one-half of the reinforcing bars are spliced at any location.

## 2.14 CONCRETE MIXING

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- A. Ready-Mixed Architectural Site Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M [and ASTM C 1116/1116M] and furnish batch ticket information.
  - 1. Clean equipment used to mix and deliver cast-in-place architectural site concrete to prevent contamination from other concrete.
  - 2. 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.
  - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

### **PART 3 - EXECUTION**

#### **3.01 FORMWORK**

- A. General: Comply with the following, unless otherwise indicated:
  - 1. Conform to ACI 318, ACI 347 and CBC Section 1906.
  - 2. Conform to ACI 318, ACI 347 and CBC Section 1906A.
- B. Structural Loads: Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- C. Geometry: Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117. Provide for necessary openings, inserts, anchorages, and other features indicated or required. Properly locate all elements.
  - 1. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
    - a. Class A, 1/16 or 1/8 inch for smooth-formed finished surfaces.
    - b. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.
- D. Form Joints: Minimize form joints and make forms watertight to prevent leakage of concrete mortar. Locate form joints at exposed concrete symmetrically about center of panel and aligned with reveals, unless otherwise indicated. Align joints symmetrically at exposed conditions.
  - 1. Seal penetrations at form ties with form joint sealant to prevent cement paste leakage.
  - 2. Provide custom form boards as required to align with reveals.
- E. Removal: Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where dismantling or stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 1. Install keyways, reglets, recesses, and the like, for easy removal.
  - 2. Do not use rust-stained steel form-facing material.
- F. Chamfers: Chamfered edges are not allowed.
- G. Chamfers: Provide chamfered edges and corners at all exposed locations, and at all locations scheduled to receive waterproofing, unless otherwise indicated.

#### **3.02 EARTH FORMS**

- A. General: Unless indicated, placement of concrete directly against soil or earth (casting "neat") shall not be permitted only with the prior approval of the Structural Engineer of Record. Concrete placed directly against earth shall require a minimum increase in concrete thickness of 1" at vertical faces. For example, footings shall be 2" wider than indicated if both vertical faces are cast against earth.
- B. Trimming and Cleaning: Hand trim sides and bottoms of soil forms and trenches. Remove loose soil, exposing undisturbed native soil, and prior to placing concrete.

#### **3.03 CONSTRUCTED FORMWORK**

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- A. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- B. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- C. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- D. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- E. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- F. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
- G. Provide bracing and shores to ensure stability of formwork and accommodate all loads. Use form ties of sufficient strength and in sufficient quantities to prevent formwork spreading. Maintain principal shores to support concrete until required strength is achieved.

### **3.04 EMBEDDED ITEMS**

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install embedded accessories level, true-to-line and plumb in accordance with manufacturer's instructions.
  - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
  - 3. Provide reveals around embedded items such as light fixtures as shown on Drawings.

### **3.05 OPENINGS, DEPRESSIONS, RECESSES AND CHASES**

- A. Size and locate formed openings, depressions, recesses and chases to accommodate products to be applied to, built-into and/or pass-through concrete Work. Coordinate size, location and placement of inserts, embedded products, openings and recesses with Work of other sections. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

### **3.06 FORM RELEASE AGENTS**

- A. General: Provide either form materials with factory-applied non-absorptive liner or field-applied form coating. Field-applied coating shall be non-staining.
  - 1. Non-absorptive Liner: Rust on steel form surfaces is not acceptable.
  - 2. Field Applied Coating: Comply with manufacturer's written instructions. Obtain written acceptance of form release agent from integral colored concrete pigment manufacturer.
    - a. Reapply coating to thoroughly cleaned and reconditioned formwork before each use.
    - b. Verify compatibility of release agents with integrally-colored concrete and all subsequently applied curing compounds, coatings, applied finishes, etc. Do not apply release agent if items are non-compatible.
    - c. Do not apply release agent where decorative wood graining is intended for concrete surface. Leave form face dry.

### **3.07 CONCRETE SURFACE RETARDERS**

- A. Coat contact surfaces of forms with surface retarder, according to manufacturer's written instructions, before placing reinforcement.

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### 3.08 FORM LINERS

- A. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

### 3.09 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of walls, steps, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg. F for 72 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
  - 1. Schedule form removal to maintain surface appearance that matches accepted mockups.
  - 2. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength, but not less than 21 days after pour.
  - 3. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
  - 4. All formwork is to be new specifically purchased for this project.
- B. Clean and repair surfaces of forms to be reused in the Work in non-exposed areas. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.10 STEEL REINFORCEMENT

- A. General: Place and secure reinforcement as indicated. Comply with CRSI publications "Manual of Standard Practice" and "Placing Reinforcing Bars".
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
  - 2. Do not bend bars more than once.
  - 3. Do not bend or straighten reinforcement in a manner injurious to the material, such as heating.
  - 4. Do not use bars with kinks or bends not indicated.
  - 5. Do not use bars with reduced cross-section due to corrosion or other cause.
  - 6. Remove and replace all defective bars.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Space reinforcement as indicated. If not indicated, maintain clear spacing of not less than the bar diameter, 1-inch, or 1-1/3 times the maximum aggregate size, whichever is greater. Where parallel reinforcing is placed in more than one horizontal layer, place as many bars as possible in the outboard layer, maintaining the required lateral clearances and spacing's. Place bars in the inboard layer in direct vertical alignment with the bars of the outboard layer. Maintain not less than 1-inch or the maximum bar diameter in the inboard/outboard layers, whichever is greater, clear space between vertically stacked bars.
- D. Accurately position, support, and secure reinforcement against displacement.
  - 1. Maintain reinforcing steel positions during placement operations. Properly reset any reinforcement that is displaced by runways, workmen and other causes.
- E. Locate and support reinforcement with bar supports to maintain minimum concrete cover as indicated or as required by ACI 318.
- F. Do not tack weld crossing reinforcing bars.
  - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

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- G. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- H. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

### 3.11 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction or Cold Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
  - 2. Locate horizontal joints in walls and columns as indicated.
  - 3. Space vertical joints in walls as indicated and as may be directed by the Architect. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  - 4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  - 5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  - 6. Align joints with reveals indicated. Provide custom cut form boards as required.
  - 7. Do not place expansion material at cold joints.
- C. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, walls and other locations, as indicated.
  - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
  - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
  - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

### 3.12 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, form-release agent, surface retarders, reinforcement, and embedded items is complete and that required inspections have been performed.
  - 1. Provide protective coatings, coverings and masking's to protect adjacent Work.
  - 2. Provide temporary runways and other appropriate equipment as necessary to access Work area and to avoid soiling or damage to existing Work.
  - 3. Prevent run-off of concrete hydration water and water polluted by agents and chemicals from soiling existing surfaces or contaminating landscape areas.
- B. Do not add water to concrete during delivery, at Project site, or during placement.
  - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
  - 2. If indicated in mix design accepted by the Architect, water added to concrete shall be observed by the Project Inspector, and shall be recorded on the delivery ticket.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

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- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.
  - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  - 2. No visible cold joints or lift lines are acceptable in the completed work.
  - 3. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.
  - 4. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
  - 5. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 6. Maintain reinforcement in position on chairs during concrete placement.
  - 7. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 8. Slope surfaces uniformly to drains where required.
  - 9. Begin initial floating using bull floats or derbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 1. When average high and low temperature is expected to fall below 40 deg. F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
  - 4. Do not use chemical accelerators unless otherwise specified and accepted in design mixtures.
- F. Hot-Weather Placement: Comply with ACI 305R and as follows:
  - 1. 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 to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

### 3.13 FINISHES, GENERAL

- A. Architectural Site Concrete Finishes: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.
- B. Architectural Site Concrete Finishes: Match accepted mockups to satisfaction of Architect.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.
  - 1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.
- D. Maintain uniformity of special finishes over construction joints unless otherwise indicated.

### 3.14 AS-CAST FORMED FINISHES

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- A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Repair and patch tie holes and defects to match the accepted mockups. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched.

Remove fins and other projections exceeding specified limits on formed-surface irregularities.

### 3.15 SKATEBOARD DETERRENTS

- A. General: Install skateboard deterrents in epoxy adhesive supplied by manufacturer, in accordance with manufacturer's instructions.
1. Install as shown. If not shown, install in symmetrical fashion on all formed edges within 4 feet (1.22 m) of adjacent grade, at intervals not to exceed 3 feet (1.1 m) O.C.

### 3.16 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 305R for hot-weather protection during curing.
- B. Begin curing cast-in-place architectural site concrete immediately after removing forms from concrete or after applying as-cast formed finishes to concrete, consistent with mockup preparation. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:
1. Moisture Curing: Keep exposed surfaces of cast-in-place architectural site concrete continuously moist for no fewer than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for no fewer than seven days. Immediately repair any holes or tears during curing period; use cover material and waterproof tape.
  3. Curing Compound: Mist concrete surfaces with water. Apply curing compound 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.

### 3.17 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports in accordance with the CBC and ACI 301.
1. Comply with the requirements of Division 01 Section "Quality Control".
  2. Comply with the requirements of Division 01 Section "Quality Control-DSA".
- B. Inspections:
1. Steel reinforcement placement.
  2. Steel reinforcement welding.
  3. Headed bolts and studs.
  4. Verification of use of required design mixture.
  5. Structural concrete placement, including conveying and depositing.
  6. Curing procedures and maintenance of curing temperature.
  7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

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1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
  - 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 C 143/C 143M; 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 C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg. F and below and when 90 deg. F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.
  - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
  - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
  - a. Test one set of two field-cured specimens at 7 days and reserve one set of two specimens for testing at 56 days.
  - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every 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.
9. 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.
10. 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.
11. 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. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

### 3.18 DEFECTIVE CONCRETE

- A. The following list includes, but is not limited to; concrete that will be deemed to be defective and non-conforming. All such concrete shall be removed and replaced with Work complying with the requirements of the Contract:

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1. Concrete not formed as indicated, not true to alignment indicated, not plumb where intended, not level where intended, not true to level or elevation intended.
  2. Concrete voided or honeycombed, including voids and honeycombs that have been cut, resurfaced or filled without prior approval of the Architect.
  3. Concrete with exposed reinforcement.
  4. Concrete with inadequate cover over reinforcement.
  5. Concrete with embedded foreign objects and debris, including sawdust, wood or metal shavings, nails, cans, trash, etc.
  6. Concrete that does not visually match the accepted mockups [or the designated design reference sample].
  7. Other non-conforming work.
- B. All concrete deemed to be defective by the Architect or in non-conformance with the contract documents is to be removed and replaced from expansion joint or cold joint to expansion joint or cold joint at no cost to the owner. Repair defective concrete as directed by the Architect, at no cost to the Owner.

### 3.19 SEALERS AND REPELLENTS

- A. General: Uniformly apply a continuous sealing coat of sealers or repellents to all exposed surfaces of architectural site concrete by power spray or roller according to manufacturer's written instructions.
1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  2. Do not apply to concrete that is less than 28 days old.
- B. Penetrating Liquid Floor and Horizontal Surface Treatment (Sealer): Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
1. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- C. Penetrating Liquid Wall and Vertical Surface Treatment (Sealer/Repellent): Prepare, apply, and finish penetrating liquid repellent treatment according to manufacturer's written instructions.

### 3.20 ANTI-GRAFFITI COATING

- A. Refer to Section 099620 Permanente Non-Sacrificial Anti-Graffiti Coating.
- B. Apply to all exposed architectural site concrete.
- C. Apply compatible sealer to exposed architectural site concrete prior to installation of Anti-Graffiti coating.

### 3.21 REPAIRS, PROTECTION, AND CLEANING

- A. Patching or sacking of damaged or defective concrete as a determined by the Architect is not permitted. Remove and replace all damaged or defective concrete from joint to joint. Remove/Repair and cure damaged or defective finished surfaces of cast-in-place architectural site concrete when accepted by Architect. Match repairs to color, texture, and for any replaced work/uniformity of surrounding surfaces and to repairs on approved mockups.
- B. Remove and replace cast-in-place architectural site concrete that does not match mockups accepted by Architect.
- C. Protect corners, edges, and surfaces of cast-in-place architectural site concrete from damage; use guards and barricades.
- D. Protect cast-in-place architectural site concrete from staining, laitance, and contamination during remainder of construction period.
- E. Clean cast-in-place architectural site concrete surfaces after finish treatment to remove stains, markings, dust, and debris.

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- F. Wash and rinse surfaces according to concrete finish applicator's written instructions. Protect other Work from staining or damage due to cleaning operations.
  - 1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural site concrete finishes.

**END OF SECTION 32 3300**

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## SECTION 32 8423 UNDERGROUND SPRINKLERS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Pipe and fittings, valves, sprinkler heads, emitters, bubblers, and accessories.

#### 1.02 RELATED REQUIREMENTS

#### 1.03 REFERENCE STANDARDS

- A. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- B. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component and control system and wiring diagrams.
- C. Shop Drawings: Indicate piping layout to water source, location of sleeves under pavement, location and coverage of sprinkler heads, components, plant and landscaping features, site structures, schedule of fittings to be used.
- D. Operation and Maintenance Data:
  - 1. Provide instructions for operation and maintenance of system and controls, seasonal activation and shutdown, and manufacturer's parts catalog.
  - 2. Provide schedule indicating length of time each valve is required to be open to provide a determined amount of water.
- E. Maintenance Materials: Provide the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Sprinkler Heads: One of each type and size.

### PART 2 PRODUCTS

#### 2.01 REGULATORY REQUIREMENTS

- A. Conform to applicable code for piping and component requirements.

#### 2.02 IRRIGATION SYSTEM

- A. Manufacturers:
  - 1. Rain Bird Sales, Inc: [www.rainbird.com/#sle](http://www.rainbird.com/#sle).
  - 2. Toro Company: [www.toro.com/#sle](http://www.toro.com/#sle).
  - 3. Substitutions: See Section 01 6000 - Product Requirements.

#### 2.03 PIPE MATERIALS

- A. PVC Pipe: ASTM D2241; 200 psi pressure rated upstream from controls, 160 psi downstream; solvent welded sockets.
- B. Fittings: Type and style of connection to match pipe.
- C. Pipe Risers at Valves: 160 psi PVC pipe.
- D. Solvent Cement: ASTM D2564 for PVC pipe and fittings.
- E. Sleeve Material: PVC.

#### 2.04 OUTLETS

- A. Manufacturers:
  - 1. Rainbird.
  - 2. Toro.
  - 3. Hunter.

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4. Substitutions: See Section 01 6000 - Product Requirements.

## **2.05 VALVES**

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify location of existing utilities.
- B. Verify that required utilities are available, in proper location, and ready for use.

#### **3.02 PREPARATION**

- A. Piping layout indicated is diagrammatic only. Route piping to avoid plants, ground cover, and structures.
- B. Layout and stake locations of system components.
- C. Review layout requirements with other affected work. Coordinate locations of sleeves under paving to accommodate system.

#### **3.03 TRENCHING**

- A. Trench to accommodate grade changes and slope to drains.
- B. Maintain trenches free of debris, material, or obstructions that may damage pipe.

#### **3.04 INSTALLATION**

- A. Install pipe, valves, controls, and outlets in accordance with manufacturer's instructions.
- B. Connect to utilities.
- C. Set outlets and box covers at finish grade elevations.
- D. Provide for thermal movement of components in system.
- E. Use threaded nipples for risers to each outlet.
- F. After piping is installed, but before outlets are installed and backfilling commences, open valves and flush system with full head of water.

#### **3.05 SYSTEM STARTUP**

- A. Prepare and start system in accordance with manufacturer's instructions.
- B. Adjust control system to achieve time cycles required.
- C. Adjust head types for full water coverage as directed.

#### **3.06 CLOSEOUT ACTIVITIES**

- A. Instruct Owner's personnel in operation and maintenance of system, including adjusting of sprinkler heads. Use operation and maintenance data as basis for demonstration.

**END OF SECTION 32 8423**

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## SECTION 32 9119 LANDSCAPE GRADING

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES:

- A. Weeding.
- B. Finish grading for lawns
- C. Finish grading for planting areas.

#### 1.02 RELATED REQUIREMENTS

- A. Division 31 Section Site Clearing
- B. Division 31 Section Earthwork
- C. Division 32 Section Decomposed Granite Surfacing
- D. Division 32 Section: Landscape Work

#### 1.03 DEFINITIONS

- A. Finish Grading: finish grading shall consist of adjusting and finishing soil surfaces with site or imported topsoil, raking grades to a smooth, even, uniform plane. Remove and legally dispose of all extraneous matter off site. Facilitate natural run-off water and establish grades and drainage indicated as part of the contract work.
- B. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 3/4-inches (19 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
- C. Finish Grading: Finish grading shall consist of finishing surfaces by raking smoothly and evenly to facilitate natural run-off water, and by removing and disposing of extraneous matter.
- D. Sub-grade: The surfaces upon which additional specified materials are to be placed, prepared, or constructed.
- E. Rough Grade: The establishment of grades to required tolerances.
- F. Finish Grade: Spot elevations (grades) are indicated based on the best available data. Contract Civil Drawings are referenced to provide additional site grading information. It is intended that constant slopes are maintained between spot elevations.
- G. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

#### 1.04 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

#### 1.05 EXISTING UTILITIES

- A. Stake and mark the location of existing utilities before commencing work.
- B. Retain and protect in operating condition all active utilities traversing the site designated to remain.

#### 1.06 QUALITY ASSURANCE

- A. Finish grade shall conform to contours, grades, lines, and shapes, as indicated on Contract Drawings, with uniform slopes between finish grades or between finish grades and existing grades.
- B. Establish finish landscape grades in a continuous, uniform line, resulting in a uniform surface with no ridges or water pockets.

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- C. Finish landscape grade tolerance shall be 0.04-feet plus-or-minus from finish elevations indicated on site drawings.

## **PART 2 - PRODUCTS**

### **2.01 SOIL MATERIALS:**

- A. Topsoil: A natural, fertile, friable soil, free from stones, roots, clods larger than 1" in diameter, noxious seeds, weeds, subsoil, undesirable insects, plant disease or any other natural objects detrimental to normal plant growth.
1. Silt plus clay content of the import soil shall not exceed 20% by weight with a minimum 95% passing 2.0-millimeter sieve.
  2. Total pore space content on a volume/volume basis shall be at least 15 percent at field capacity.
  3. Permeability rate shall be not less than one inch per hour or more than 20 inches per hour.
  4. The sodium absorption ratio (SAR) shall not exceed 6 and the electrical conductivity (ECE) shall not exceed 2.0 milliohms per centimeter at 25 degrees centigrade.
  5. Soluble boron shall be no greater than 1.0 part per million (mg/l).
  6. Soil pH range shall be 6.0 - 7.9.
  7. Maximum concentration of soluble chloride shall be 150 parts per million.
  8. Maximum concentration of heavy metals shall not exceed the following when the pH is between 6 and 7:
    - a. Arsenic: 1 ppm
    - b. Cadmium: 1 ppm
    - c. Chromium: 5 ppm
    - d. Cobalt: 1 ppm
    - e. Lead: 15 ppm
    - f. Mercury: 0.5 ppm
    - g. Nickel: 2.5 ppm
    - h. Selenium: 1.5 ppm
    - i. Silver: 0.25 ppm
    - j. Vanadium: 1.5 ppm
  9. Petroleum hydrocarbons shall not exceed 100 mg/kg dry soil.
  10. Aromatic volatile organic hydrocarbons shall not exceed 2 mg/kg dry soil.
- B. Obtain imported topsoil from approved local sources.
- C. All topsoil to be used for planting, regardless of whether import or on-site in origin, shall be tested as described in Part 3 of Section 329300.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION:**

- A. Verification of conditions: Prior to commencing the finish grading, review the installed work of other trades and verify that their work is complete.
1. Rough Grading: Grading in planting areas (except raised planter areas) shall be established to within plus or minus 0.10 foot prior to beginning of finish grading.
- B. Import topsoil only when necessary to supplement site soil to achieve grades shown on Drawings, or if site soil is unsuitable for planting.

### **3.02 PREPARATION:**

- A. Weeding: Before finish grading, weeds and grasses shall be dug out by the root or sprayed with an herbicide and disposed of off-site. This procedure is outlined in Section 329300-Landscape Work.
- B. Remove debris, roots, branches, weeds, stones, in excess of 1/2-inch (13 mm) in size and clumps of earth that do not break up. Before and during finish grading, remove weeds and grasses, including roots, and dispose off-site.

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- C. Remove soil contaminated with petroleum products and legally dispose off-site.

### **3.03 INSTALLATION:**

- A. General: When rough grading and weeding have been completed, and the soil has dried sufficiently to be readily worked, lawn and planting areas shall be graded to the elevations indicated on the Drawings.
1. Grades indicated on Drawing are grades that will result after thorough settlement and compaction of the soil.
  2. Grades not otherwise indicated shall be uniform finish grades and, if required, shall be made at the direction of the Architect.
  3. Finish grades shall be smooth, even, and a uniform plane with no abrupt change of surfaces.
  4. Soil areas adjacent to buildings shall slope away from the building to allow a natural run-off of water, and surface drainage shall be directed as indicated on the drawings by remodeling surfaces to facilitate the runoff water at 2% minimum grade.
  5. Low spots and pockets shall be graded to drain properly.
- B. Drainage: Finish grade with proper slope to drains.
1. Flow lines, designated or not, shall be graded and maintained to allow free flow of surface water.
  2. If any drainage problems arise during construction period due to Contractor's work (such as, but not limited to, low spots, slides, gullies and general erosion), the Contractor shall be responsible for repairing these areas to a condition equal to their original condition, and in so doing shall prevent further drainage problems from occurring.
- C. Prior to placing backfill, remove rock, aggregate base, concrete, and deleterious materials to a depth of 18 inches below soil grade in planter areas. Cross-rip subsoil of friable soil to a depth of 12-inches.
1. Place a minimum of [15-inches] of topsoil backfill in planters.
  2. Refer to Section 329300 "Landscape Work" for soil materials.
- D. Toe of slope: To prevent soil creep or erosion across pavement, where pavement (walk, curb, etc.) is at the toe of a slope, finish grade is to level out or swale slightly at least 12-inches before reaching pavement.
- E. Moisture Content: The soil shall not be worked when the moisture content is so great that excessive compaction occurs, nor when it is so dry that dust may form in the air or that clods do not break readily. Water may be applied, if necessary, to provide moisture content for tilling and planting operations. It is the Contractor's responsibility to control dust that is spread as a result of grading operations.
- F. Grades: The finish grade in areas to be planted with turf shall be 1-inch below grade of adjacent pavement, walks, curbs, or headers. Finish grade in shrub areas shall be 1 1/2-inches below adjacent surfaces. Exceptions may be made when drainage conditions require flush grades, as directed by the Architect.
- G. Compaction: Soils in planted areas shall be loose and friable, yet firm enough that no settling occurs from normal foot traffic or irrigation.

### **3.04 FIELD OBSERVATION:**

- A. It is the Contractor's responsibility to contact the Architect 48 hours or two working days in advance of each agreed observation or conference.
- B. Schedule for On-Site Reviews: at completion of finish grading and prior to any planting operations.
1. See "Site Observation" in Part 3 of Section 329300-Landscape Work to coordinate inspections and review of work.

**END OF SECTION 32 9119**

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## SECTION 32 9300 LANDSCAPE WORK

### PART 1 - GENERAL

#### 1.01 SECTION INCLUDES

- A. Soil Prep and Fertilization.
- B. Planting Operation.
- C. Planting Materials.
- D. Topsoil and Planter Mix.
- E. Agronomic Testing.
- F. Drainage Materials.
- G. Jute Mesh and Erosion Control.
- H. Mulching.
- I. Hydroseeding
- J. Sod
- K. Pruning
- L. Tree stabilization.
- M. Edgings.
- N. Tree grates.
- O. Root Barriers.

#### 1.02 RELATED REQUIREMENTS

- A. Division 12 Section Site Furnishings.
- B. Division 31 Section Site Clearing
- C. Division 32 Section Finish Grading
- D. Division 32 Section Landscape Irrigation
- E. Division 32 Section Landscape Maintenance
- F. Division 33 Section Storm Drainage Utilities

#### 1.03 REFERENCE STANDARDS

- A. American Association of Nurserymen, Inc. (AAN)
  - 1. American Standard for Nursery Stock, latest edition (ANSI).

#### 1.04 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum laced as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Exterior 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 diameter and depth recommended by ANSI Z60.1 for type and size of exterior plant required.
- D. Bare-Root Stock: Exterior plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of exterior plant required.
- E. Bio-filtration Planting Soil: Imported specialty Soil manufactured offsite by Gail Materials required for storm water infiltration.

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- F. Root Zone: Imported specialty soil manufactured offsite by Gail Materials to be placed beneath turf fields.
- G. Clump: Where three or more young trees were planted in a group and have grown together as a single tree having three or more main stems or trunks.
- H. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of 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 exterior plant required.
- I. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of exterior plant.
- J. Finish Grade: Elevation of finished surface of planting soil.
- K. Sub-grade Elevations: Excavation, filling and grading required to establish elevations is shown on drawings. Coordinate all work with grading contractor in order to arrive at rough grades that will allow tolerance for topsoil in planting areas, soil amendments and ornamental mulch as required in other sections of this specification. Contractor to assume tolerance of rough grades established at  $\pm 0.09$  feet (less than 1 tenths of a foot)
- L. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- M. Multi-Stem: Where three or more main stems arise from the ground from a single root crown or at a point right above the root crown.
- N. Planting Soil: Native or imported topsoil; mixed with soil amendments.
- O. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
- P. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- Q. Pruning: As designated on contract drawings. Items not specifically indicated or specified, but normally required to conform with such work, are considered part of the work.

#### **1.05 SUBMITTALS**

- A. WITHIN 30 DAYS OF START OF THE ROUGH GRADING OPERATIONS:
  - 1. Submit a certificate indicating all plant material has been secured for the project and is available.
  - 2. Submit documentation that all plant material has been ordered in accordance with Article 1.6 of this section.
- B. CERTIFICATION: Submit the following:
  - 1. Certificates of inspection as required by governmental authorities when transporting materials into the state.
  - 2. Bulk Materials: Submit a certificate of delivery for all material in containers or bulk.
- C. TEST REPORTS: Submit the following:
  - 1. Agronomic Soils Laboratory Test Report(s) including required amendments and maintenance recommendations.
- D. PRODUCT DATA: Submit the following:
  - 1. In accordance with Division 1 Section "Submittal Procedures", submit complete manufacturer descriptive literature and specifications for proprietary materials and any additional items required by the Architect. Prior to start of construction and submittals; furnish to the Architect the list of items to be submitted and reviewed.
    - a. Soil Amendments (as identified in Agronomic Soils Report).

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- b. Fertilizer (as identified in Agronomic Soils Report).
- c. Plant Tablets.
- d. Stakes and Guys.
- e. Tree Ties and Vine Ties.
- f. Seed Mixtures.
- g. Hydroseed Materials.
- h. Mulch.
- i. Hydroseeding: Furnish certificate, in writing, stating that the hydroseeding has been installed as specified.
- j. Edging Material.
- k. Filter Fabric.
- l. Drainage Materials.
- m. Accessory Material.
- n. Other soil additives per Agronomic Soils Report.
- o. Rock mulch.
- p. Submit other data substantiating that materials comply with specified requirements. Such certificates may be tags, labels, and/or manufacturers literature. All submittals shall be reviewed and accepted by the Architect before contractor begins work.
- q. Substitution Request
  - 1) If any plant specified is not obtainable, submit a written substitution request to the Architect during the bidding period.
  - 2) Substitutions of plant material will not be permitted unless accepted in advance in accordance with the provisions of Division 1 Section "Product Requirements."
  - 3) The Contractor is responsible for contract growing all required plant material for to project to ensure availability in the size and requirements of the project.
  - 4) All substitution requests for any material must be made during the bid process. No substitution requests will be permitted after the bid process or during.
- r. With submittal of Bid Documents, submit complete list of plant materials to be provided, including unit prices for plants and for installation. Include:
  - 1) Quantity.
  - 2) Size.
  - 3) Botanical Name.
  - 4) Plant Unit Price.
  - 5) Installation Unit Price.
- 2. PLANTING SCHEDULE: Submit proposed planting schedule at least two months prior to planting any materials, indicating dates for each type of landscape work coinciding with normal seasons for such work. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. If dates need to be revised after acceptance of planting schedule, document reasons for delays and submit for acceptance.
- 3. Submit two photos of each tree shrub and groundcover with a person in the image to be used on the project to the architect for review. Photos are to be of the actual material tagged, secured and to be used for the project at the sourced nursery. No plants may be delivered or planted prior to approval by Architect.

## 1.06 QUALITY ASSURANCE

### A. QUALIFICATIONS

- 1. Nursery Qualifications: Regularly engaged, for the preceding ten years, in the production of planting materials equivalent in species and size to those required.
  - a. Stocked, and having a demonstrated ability to provide plant materials required within the constraints of the accepted construction schedule.
  - b. Landscaper's Qualifications: Regularly engaged and specializing, for the preceding ten years, in the installation and maintenance of planting materials equivalent in species and size to those required.

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- 1) Capable of furnishing a verifiable list of not less than five projects of equivalent type successfully completed within the preceding two years.
  - 2) Subcontracts: Landscape work to a single firm specializing in landscape installation.
2. Pre-Installation Conference: Schedule in advance of beginning work of this section. Arrange for attendance by Owner, Architect, and landscaping subcontractor. Review intent of Contract Documents and resolve conflicts. Prepare minutes of conference and distribute to attendees within five (5) days.
3. Source Quality Control
  - a. General: Comply with regulations applicable to shipping of landscape materials.
  - b. Analysis and Standards: All materials shall be of standard, approved and first-grade quality and shall be in prime condition when installed and accepted. Any commercially processed or packaged material shall be delivered to the site in the original unopened container bearing the manufacture's guaranteed analysis. The Contractor shall supply the Architect with a sample of all materials accompanied by analytical data from an approved laboratory source illustrating compliance of bearing the manufactures guaranteed analysis.
4. Soil-Testing Laboratory Qualifications: An independent 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.
5. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
  - a. Report suitability of topsoil for plant growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
6. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 3/4-inches (19 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
  - a. Obtain topsoil only from naturally, well drained sites where topsoil occurs in a depth of not less than 4"; do not obtain from bogs or marshes. All topsoil is to be tested and analyzed by an independent laboratory before delivery to site, as indicated in Article 3.3.
7. Contractor shall provide the Architect with location of soil, crops previously planted on such soil within the last two years, and the USGS soil survey classification and name.
8. Trees, Shrubs and Plants: Provide trees, shrubs and plants of quantity, size, genus, species and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1-1980 "American Standard for Nursery Stock". Provide healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free from disease, insects, insect eggs, larvae and defects such as knots, sun-scald, injuries, abrasions, overlapping surface roots, or disfigurement. Central leaders of all trees shall be intact, undamaged, with evenly spaced lateral branches.
  - a. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above the ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above the ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

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9. Label all trees and shrubs with securely attached waterproof tag bearing legible designation of botanical and common name. Where formal arrangements and consecutive order of trees is shown, select stock for uniform height/spread, and label with number to assure symmetry in planting.
10. Stock Review: The Architect will review trees and shrubs at site before planting with requirements for genus, species, variety, size and quality. The Architect retains right to further review trees and shrubs for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of the work. Remove rejected vegetation immediately from project site. Contractor shall request review of such stock by the Architect by delivering notice, in writing, 72 hours in advance.

#### **1.07 DELIVERY, STORAGE AND HANDLING**

- A. Deliver exterior plants freshly dug.
- B. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
- C. Packaged Materials: Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.
  1. Protect plants from sun or drying winds. Protect and maintain plants that cannot be planted immediately upon delivery.
  2. Do not drop plant material.
  3. Do not pick up container planter material by stems or trunks.
  4. Protect from wind.
  5. Water as required.
  6. Do not prune trees and shrubs before delivery except as approved by Architect. Do not bend or bind trees or shrubs in such manner as to damage bark, break branches or destroy natural shape. Provide protective covering during delivery, and provide protection on site from traffic, pedestrians, and deleterious effects of climate while planting operations are in progress. Dropped or damaged stock will not be accepted.
  7. Deliver trees and shrubs after preparations for planting have been completed and plant immediately after approval of plant materials locations. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture. Do not remove container grown stock from containers until planting time.
    - a. Do not pick up plants by stems or truck. Handle planting stock by root ball.
    - b. Do not remove container - Grown stock from containers before time of planting.
    - c. Water root systems of exterior plants stored onsite with a fine-mist spray.
    - d. Water as often as necessary to maintain root systems in a moist condition.
  8. Plant material shall not be stored on the jobsite for more than 48 hours before planting. Contractor shall schedule nursery deliveries in sub-groups as necessary to comply with this requirement.
  9. Deliver accessory materials in manufacturer's original, unopened packaging with identifying labels affixed and legible in accordance with state law. Deliver plants with identifying tags affixed. Contractor shall notify Architect 48 hours in advance of plant material delivery for observation. Review plants with Landscape Architect to confirm that they are the plants which had previously been tagged and supplied. The Architect reserves the right to reject the following:
    - a. Plant materials not identifiable as previously selected.
    - b. Materials not accompanied by required certificates.
    - c. Plant materials where damage to rootball, trunks, or desiccation of leaves has been caused by inadequate protection during delivery.

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- d. Plant material not matching the form, shape, or growth habit required for the design intent of the Project.
- e. Horticultural or visual defects in material.
- f. Plant material pruned prior to delivery.
- g. Plant material with detrimental pests.

#### 1.08 PROJECT CONDITIONS

- A. Proceed with and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.
  - 1. Planting Restrictions: Coordinate planting periods with maintenance periods to provide required maintenance from date of substantial completion.
    - a. Plant or install materials during normal planting seasons for each type of landscape work required.
  - 2. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed without having detrimental effects on the plant material, or finished product.
  - 3. Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns unless otherwise acceptable to Architect.
    - a. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.
  - 4. Contractor shall verify locations of all existing utilities, whether shown on plans or not. The Contractor shall notify members of Underground Service Alert (U.S.A.) two (2) working days in advance of performing any excavation work by calling the toll-free number 1-800-227-2600
  - 5. After determining location of underground utilities, perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.
  - 6. When conditions detrimental to plant growth are encountered, such as rubble fill, hardpan condition, adverse drainage conditions, or obstructions, notify the Architect before planting. Remove all material deemed unsuitable for plant growth as directed by the Architect.
  - 7. No landscape materials may be planted before an irrigation operation and coverage test is completed by the Architect.
  - 8. No landscape materials may be planted before finish grade is reviewed by the Architect.
  - 9. Existing Trees:
    - a. Prior to the beginning of any clearing, grubbing, trenching, or excavation on site, the general contractor, grading contractor, project arborist, landscape contractor, and the Architect shall meet in a pre-construction conference to discuss grading near existing trees.
    - b. The contractor shall protect all existing trees and shrubs scheduled to remain against injury or damage, including cutting, breaking or skinning of roots, trunks or branches. No blasting of rock shall occur in any area adjacent to existing trees without prior written consent of the Architect.
    - c. No trees or shrubs are to be removed, trimmed, or cut without prior approval of the Architect.
    - d. Prior to the beginning of the clearing and grading phase of the project, a continuous, temporary, six foot (6') high chain link fence shall be erected around the drip line of all trees scheduled to remain, unless otherwise specified by the Architect. The temporary fencing shall be erected prior to commencing any other work on the project. No construction activity shall be allowed within the limits of this fencing unless directed by the Architect. The temporary fencing shall remain in place during the entire construction period and shall not be removed until directed by the Architect.

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- e. Grading beneath trees to be saved shall be given special attention. Every effort shall be made to avoid creating conditions adverse to the tree's health. The natural ground within the drip lines of trees to be preserved shall remain as undisturbed as possible. Grading within the protected root zone of trees to be preserved will not be permitted unless specifically approved by the Architect prior to beginning of proposed grading.
- f. If during construction or grading (grading, excavation, etc.) tree roots of 2" in diameter or greater are encountered, work shall stop immediately and a Certified Arborist, approved in advance by the Architect, shall be contracted for a root inspection. Root cutting of any roots over 2" in diameter must have prior approval from the Architect. All cuts are to be made with appropriate equipment, as to not affect the plant material.
- g. Major roots one inch (1") or greater in diameter encountered within the drip line of the tree in the course of excavation or trenching shall not be cut and shall be kept moist and covered with earth as soon as possible. Shredding of roots or damaged caused by trenching or grading equipment is not permitted.
- h. Roots one half inch (1/2") to one inch (1") in diameter which are severed shall be trimmed cleanly and covered with earth as soon as possible.
- i. All trenching beneath the drip line of trees to remain shall be done with hand tools only. No mechanical trenching or excavation is allowed within the drip line of existing trees at any time, or where roots are encountered outside the dripline of the tree.
- j. Branches interfering with construction but not designated for removal may be removed only as directed by the Architect.
- k. Any pruning, cutting, or trimming of any trees will be performed by an International Society of Arboriculture Certified Arborist or certified tree worker or in accordance with the National Arborist Association and/or International Society of Arboriculture pruning standards. Cutting of 2" diameter limbs or greater or major dead wooding shall require approval of the Architect.
- l. Trees or shrubs scheduled to remain and damaged by construction operations shall be repaired by the contractor in a manner acceptable to the Architect. Damaged trees and shrubs shall be repaired promptly to prevent progressive deterioration. Repair or replacement of trees and shrubs shall be at the contractor's expense as determined by the Architect. Contractor shall be held fully liable for damage caused to trees and shall be assessed fees based on the International Society of Arboriculture "Guide for Plant Appraisal", as determined by the project Arborist; fees will be assessed for: 1) any injury to the trunk, limbs, or root system, and (2) for the value of any tree requiring removal subsequent to injury or treatment that varies from these Specifications.
- m. A permit from the City Arborist may be required prior to pruning or removing any trees, as required by applicable codes or ordinances.
- n. Parking of vehicles, equipment or storage of materials under the drip line of existing trees shall not occur at any time.
- o. Wash all existing and new trees weekly to remove dust and debris during construction.

## 1.09 SCHEDULING

- A. Within 30 days after the commencement of initial grading, furnish documentation to the Architect that all plant material has been secured for the project and is available. Contractor shall be responsible for payments and deposits required by the grower or plant consultant to secure, maintain, and grow plant material indicated on the Contract Drawings.

## 1.10 WARRANTY

- A. Special Warranty: Warrant all plant material in writing where installer agrees to repair or replace plantings and accessories that fail in materials, workmanship or growth within specified warranty period.
  - 1. Failures include, but not limited to, the following:

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- a. Death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, abuse by owner.
- b. Structural failures including plantings falling or blowing over including during high wind events.
- c. Faulty operation of tree stabilization edgings tree grates.
- d. Deterioration of metals, metal finishes and other materials beyond normal weathering.
- e. Material not thriving.
- f. Warranty periods begin from date of final completion:
  - 1) Trees, vines, shrubs: One year.
  - 2) Ground cover and turf: One year.
2. Warrant plant material, installed, or relocated under the contract, in writing, for a period of one year (after beginning of maintenance period) against defects including death, and unsatisfactory growth, except for defects resulting from neglect, abuse or damage by others.
3. Remove and replace trees, shrubs or other plants found to be dead, yellowing, defoliating, or in unhealthy condition, or other defective materials during warranty period at no additional cost to the Owner. Replace trees and shrubs, which in the opinion of the Architect, are in unhealthy condition at end of warranty period. The Architect shall be the sole judge as to the condition of the material. All replacement materials and installation shall comply with the drawings and specifications. Another inspection may be conducted at end of warranty period to determine acceptance or rejection.
4. Upon receipt of written notice from Owner of the loss of any warranted plant materials during the warranty period, the subject plant materials shall be promptly replaced with the same species originally planted, and of a size closely approximating the size of the plant, if normal growth had occurred since the original planting. Replacements shall be subject to the requirements of this specification.
5. When plants are replaced, advise the Owner, in writing, of the new establishment maintenance period equal to the one year.
6. Plant material must be replaced within ten (10) days of written notification, and shall be installed in accordance with these specifications.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Design is based on the use of products manufactured by the following.
  1. Best Fertilizer Company, Lathrop, CA
  2. BFI Organics, Milpitas, CA 408-262-1401
  3. Deep Root Corporation, Burlington, CA 800-458-7668.
  4. Delta Bluegrass Co. Stockton, CA (209) 469-7979
  5. Horizon, Roseville, CA 916-780-2033.
  6. Landscape Forms, represented by Rebecca Casey, 510~594-1777.
  7. LH Voss, Dublin, CA 925-560-9920
  8. Mirafi, Inc. Charlotte, NC. 800-438-1855.
  9. NDS Drainage Products, 800-726-1998.
  10. Pacific Coast Seed. 533 Hawthorne Place, Livermore, CA 94551 (925) 373-4417
  11. Pacific Sod, Patterson, CA, 800-542-7633.
  12. Redi-Grow Corporation, Sacramento, CA, 800-654-4358.
  13. S&S Seeds, Camarillo, CA 805-684-0436.
  14. Silverado Building Material, Sacramento, CA 916-361-7374.
  15. Soil and Plant Laboratory, Inc., Santa Clara, CA 408-727-0330.
  16. Stabilizer, Inc. Phoenix, AZ 800-336-2468.
  17. Sunland Analytical Labs, Rancho Cordova, CA 916-852-8557.
  18. TMT Enterprises, San Jose, CA 408-432-9040.
  19. Whitecap, Inc. Rancho Cordova, CA 916-636-3215.

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20. Agrono-Tec Seed Co., Wildomar, CA, 800-543-4109.
21. Aguiñaga Fertilizer Co., Inc., Irvine, CA, 949-786-9558.
22. Best Fertilizer Co., Lathrop, CA.
23. Conwed Designscape, Ladyscape, MI, 714-532-5548/800-833-4798.
24. Deep Root Corporation, Burlington, CA, 800-458-7668.
25. Ecology Controls, S&S Seeds, Camarillo, CA, 805-684-0436.
26. Fore Sight Products, Inc., Commerce City, CO, 800-925-5360.
27. Gail Materials, Corona, CA, 951-664-6106.
28. KRC Rock, San Marcos, CA, 800-427-0572.
29. Landscape Forms, represented by David Silverman & Associates, 818-541-6691.
30. Mirafi, Inc., Charlotte, NC 800-438-1855, represented by James Heidt & Associates, Montrose, CA, 818-248-9677/800-233-0512.
31. NDS Drainage Products, 800-726-1998.
32. Quality Turf, Temecula, CA, 800-721-4800.
33. Pacific Sod, Camarillo, CA, 800-762-3027.
34. Permaloc Corporation, Holland, MI, 616-399-9600.
35. S&S Seeds, Camarillo, CA, 805-684-0436.
36. Soil and Plant Laboratory, Inc., Orange, CA, 714-282-8777.
37. Southern California Organic Fertilizer Company, El Monte, CA, 714-750-3830.
38. Southland Sod Farms, Port Hueneme, CA, 805-488-3585.
39. Stabilizer, Inc., Phoenix, AZ, 602-952-8009/800-336-2468.
40. V.I.T. Company, Escondido, CA, 760-480-6702.
41. West Coast Turf, Las Vegas, NV, 800-649-8873.
42. Whitecap, Inc., Santa Ana, CA, 714-258-3300.
43. Whittier Fertilizer, Pico Rivera, CA, 310-699-3461.
44. Wayside Lumber, Rancho Cordova, CA, 916-635-9090.
45. EPIC Plastics, Cerritos, CA, 562-403-3848.
46. Wallace Labs, El Segundo, CA, 310-615-0116.
47. Whittier Fertilizer, Pico Rivera, CA, 562-699-3461.
48. Materials shall be the products of one manufacturer and shall be either the ones upon which the design is based, or the products of manufacturer accepted in advance. No substitutions will be permitted.

## 2.02 SOIL

- A. TOPSOIL: Site to be rough graded to elevations shown on Civil Drawings. Topsoil will be required behind curb areas and in planting area. Provide on-site, import, or non-processed topsoil in planting areas as needed to complete rough grading which is fertile, friable, and natural loam in accordance with Article 2.3. Topsoil shall be from agricultural sources, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 3/4-inch in any dimension, and other extraneous or toxic matter harmful to plant growth.
- B. All topsoil to be used for planting, regardless of whether import or on-site in origin, shall be tested as described in Part 3 of this Section.
- C. Biofiltration Planter Soil
  1. Pre-manufactured soil as purchased by Gail Materials.
    - a. The soil shall be a blend of 4 parts by volume washed sport sand to 1 part sandy loam topsoil. The gravel content shall not exceed 15% by weight with the largest allowable particle not exceeding 1/4 inch.
    - b. Chemistry:
      - 1) The pH shall be in the range of 6-8.0.
      - 2) Salinity shall not exceed 3.0 dS/m.
      - 3) Sodium: Sodium absorption ratio (SAR) shall not exceed 5.0
      - 4) Boron shall not exceed 1 ppm.

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- c. Amendments:
  - 1) The top 6 inch layer the following shall be uniformly blended by means of a pug mill or equal.
    - (a) Amount/cubic yard
      - (1) 10% by volume of Reed Sedge Peat Moss
      - (2) 25% 8X20 Lassenite Pozzolan
      - (3) 15 lbs. 6-20-20 fertilizer
      - (4) 50 lbs. Gypsum
  - 2) For the depth below 6 inches uniformly blend by means of a pug mill or equal
    - (a) Amount/cubic yard
      - (1) 10% by volume AXIS medium grade.
- d. Location(s)
  - 1) Use in designated infiltration planter areas and bioswale areas, see planting plans.
  - 2) Depth shall be per details.
  - 3) Available through Gail Materials, Corona, CA (951) 667-6106
  - 4) Contact: Dave Dzwilewski
- 2. Root zone for sand based turf and materials.
  - a. Pre-manufactured soil by Gail Materials.
  - b. Sand: Refer to detail on approved plans for depth
    - 1) Meet the following gradation:
      - (a) Sieve No. Percent passing (by weight)
        - (1) 100
        - (2) 75-100
        - (3) 40-100
        - (4) 0-50
        - (5) 0-12
        - (6) 0-5
    - 2) Chemistry
      - (a) Salinity: Saturation extract conductivity (ECe) shall be less than 3.0 dS, @ 25 degree C.
      - (b) Sodium: Sodium absorption ratio (SAR) shall be less than 6.0.
      - (c) Boron: Saturation extract concentration shall be less than 1.0 ppm.
      - (d) Reaction pH of saturation paste shall be 5.5 to 7.8 without height lime content.
  - c. Bark: 1 to ¼ inch fir or pine bark. Refer to planting details for depth.
    - 1) Particle Size Distribution:
      - (a) Sieve No. Percent Passing
      - (b) 9.51 mm (3/8 inch) 100
      - (c) 6.35 mm (1/4 inch) 95
      - (d) 500 micron (0.02 inch) 0-30
    - 2) Minimum 90 percent organic by dry weight as determined by ash method.
    - 3) pH shall be in the range of 4.0-5.5 as determined in saturation paste.
    - 4) Salinity shall not exceed 2.0 dS/m as determined in saturation extract.
    - 5) Dry bulk density shall be in the range of 400 to 580 pounds per cubic yard.
    - 6) Fir or pine sawdust or greenwaste compost are not acceptable alternatives.
  - d. Soil Mixture: The soil mixture shall be a bind of one part 0-1/4 fir or pine bark and 6 parts of specified sand. Refer to approved details for depth. The following amendments shall be added and uniformly blended at tan offsite facility (equal to Gail Materials) into the sand bark mixture prior to placement on the field.
    - 1) Nitroform (38%N, 27% WIN): 2/3 pound
    - 2) 6-20-20 Commercial Fertilizer: 1 pound
    - 3) Solomitic Limestone (Kaiser AG 65): 1.5 pounds

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- 4) Iron Sulfate (31% Fe): 5 ounces
- e. Location(s)
  - 1) Use in designated field areas.
  - 2) Depth shall be per details.
  - 3) Available through Gail Materials, Corona, CA (951) 667-6106
  - 4) Contact: Dave Dzwilewski

## 2.03 SOIL AMENDMENTS

### A. On Grade:

1. The initial application of fertilizers and amendments to be tilled into the soil during soil preparation operations shall be established after soil testing has been conducted by Contractor. An estimated quantity is indicated below for bid purposes only. This estimated quantity does not include mulching, fertilizer tablets, additional topsoil necessary to meet specified grades and fertilizer applications for after planting. After soils analysis recommendations are made to the Architect quantifying the actual amount of amendments required and recommendations have been accepted by the Architect, the Contractor shall, without delay, determine any cost impacts whether credit, no change, or addition, to the Contract Amount. As an integral part of the bid for Landscape Work, provide a Lump Sum bid amount for fertilizers and amendments as described below.
2. Application Rates (FOR BID PURPOSES ONLY):
  - a. Sixty (60) lbs. of Tri-C Humate per 1,000 square feet.
  - b. Nineteen (19) lbs. of 6-20-20 fertilizer per 1,000 square feet.
  - c. Six (6) cubic yards of Aguiñaga GPS2, nitrogen stabilized compost per 1,000 square feet.
  - d. 50-lbs Agricultural Gypsum, per 1,000 square feet.
3. Pot or Raised Planter Soil Mix: Prepare and backfill pots with a mix of the following per cubic yard:
  - a. Jardinier Capillary Soil
  - b. 12-12-12 Commercial Fertilizer
  - c. Organic Amendment - 1/3 cubic yard
  - d. Fine Sand - 1/3 cubic yard
  - e. 12-12-12 Commercial Fertilizer - 1 pound
  - f. Iron Sulfate - 2 pounds
4. Actual amendment rates and type shall be per soil test recommendations.
5. Imported Topsoil
  - a. Provide natural, fertile, friable soil free from stones, noxious weeds, seeds, roots, subsoil or other material detrimental to normal plant growth. Topsoil acidity range (pH) shall be between 6.5 and 7.5 containing a minimum of 4 percent and a maximum of 25 percent organic matter.
  - b. Reuse surface soil stockpiled onsite. Verify suitability of stockpiled surface soil to produce top soil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
    - 1) Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain top soil displaced from naturally well drained sites where topsoil occurs at least 4 inches deep; do not obtain from [agricultural land], bogs or marshes. Obtain soil from local sources acceptable to the Architect.
    - 2) Silt plus clay content of soil shall not exceed 15 percent by weight with a minimum 95 percent passing a 2 millimeter sieve.
  - c. Obtain imported topsoil from local sources acceptable to the Architect.
  - d. Silt plus clay content of soil shall not exceed 15 percent by weight with a minimum 95 percent passing a 2-millimeter sieve.
6. Soil Amendments:
  - a. "Nitrified Redwood Compost": 0.56 to 0.84% N based on dry weight, treated with relative form of nitrogen (NH<sub>3</sub>).

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- 1) Particle Size
- 2) 95% - 100% passing 6.35 mm standard sieve.
- 3) 80% - 100% passing 2.33mm standard sieve.
- 4) Salinity: The saturation extract conductivity shall not exceed 3.5 millimhos/centimeter at 25 degrees (25N) centigrade as determined by saturation extract method.
- 5) Iron Content: Minimum 0.08% dilute acid soluble Fe on dry weight basis.
- 6) Ash: 0 - 6.0% (dry weight)
- 7) Acidity range (ph) shall be between 5.5 and 7.5.
- 8) Actual organic content shall be a minimum 280 pounds (lbs.) per cubic yard.
- 9) As available from: Redi-Grow Corporation, 909 Elder Creek Road, Sacramento, CA 95828
- b. Organic soil amendment shall be Aguinaga GPS2.
  - 1) Particle Size:
    - (a) 90-100 percent passing 6.35 mm standard sieve.
    - (b) 80-100 percent passing 4.75 mm standard sieve.
  - 2) Salinity: The saturation extract conductivity shall not exceed 6.5 milliohms/centimeter at 25 degrees Centigrade as determined by saturation extract method.
  - 3) Iron Content: Minimum 0.08 percent dilute acid soluble iron on dry weight basis.
  - 4) Actual organic content shall be a minimum of 280 pounds (lbs.) per cubic yard.
7. Fertilizers
  - a. Tri-C Humate. Provide per manufacturers specification.
  - b. Fertilizer Tablets: Fertilizer Tablets: The following is to be used in the planting of container grown material. Follow manufacturer's application rates.
    - 1) Best-Paks "20-10-5" fertilizer packets. Packets to be made up of a minimum of 20% Nitrogen, 10% Phosphorus, 5% Potash. Use 1 Pak per 1-gallon container, (G.C.), 3 Paks per 5 G.C., 9 Paks per 15 G.C. and 12 Paks per boxed specimen. Evenly distribute as shown in details.
  - c. Commercial Fertilizer: First Quality Commercial Fertilizer, as specified in Agronomic Soils Report.
  - d. Related Materials:
    - 1) Pre-Planting Herbicide: Phydura, or equal.
    - 2) Pre-Emergent Weed Control: Ronstar-G, Treflan, Eptam, Vegitex, or equal.
    - 3) Organic Soil Amendment: Aguinaga G-PS2.
    - 4) Peat Moss: Sphagnum peat moss, Canadian or European variety, free from alkali.
    - 5) Soil Sulfur: First quality commercial grade.
    - 6) Ferrous Iron Sulfate: Chelated first quality commercial grade.
    - 7) Agricultural Gypsum: First quality commercial grade.
    - 8) Best "Ammonium Phosphate" 16-20-0 with net less than 16% total nitrogen, 20% available phosphoric acid and 0% soluble potash.
    - 9) Good Humus.
    - 10) Root Hormone: Super Thrive.
    - 11) Compost: Aguinaga G-PS2.

## 2.04 PLANT MATERIALS

- A. Quality: Provide trees, shrubs, and other plants of size, form, genus, species and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock".
- B. Deciduous Trees: Provide trees of height and caliper scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.

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1. Lateral scaffolds shall be radially distributed around the trunk. The lateral branch shall be no more than 2/3 the diameter of the trunk. Trunk to be measured 1" above the branch (lateral scaffold).
2. The minimum acceptable length of the most recent season's shoot growth for slow growing trees shall be not less than 8"; for fast growing trees not less than 12".
3. The minimum acceptable height of trees is 6'-0" when planted, or as determined by Architect.
4. Needle Leafed and Broad Leafed Evergreen Trees: Provide evergreens of sizes shown or listed. Where dimensions are shown, they indicate minimum spread for spreading and semi-spreading type evergreens and height for other types, such as globe, dwarf, cone, pyramidal, broad upright, and columnar. Provide normal quality evergreens with well-balanced form complying with requirements for other size relationships to the primary dimension shown.
  - a. The minimum acceptable height of trees is 6'-0" when planted, or as determined by Architect.
5. Multi-Trunk Trees: Provide sizes shown or listed. Tree is to have a minimum of three (3) dominant trunks with appropriate caliper size and adequate spread.
6. Shrubs: Provide shrubs of the size shown and with not less than the minimum number of canes required by ANSI Z60.1 for type of shrub required. Provide container grown stock.
7. Ground Cover: Provide plants established and well-rooted in removable containers, in flats, or integral peat pots and with not less than minimum number and length of runners required by ANSI Z60.1 for the size shown or listed.
8. Vines: Provide vines with good, well-established root systems within the container, and devoid of any abrasions, and or damage to stem.

## 2.05 SOD

### A. Lawn Sod:

1. Nursery-grown sod shall have the following characteristics:
  - a. Sod for planting areas shall be dense, healthy, field-grown on sand fumigated soil with the grass having been mowed at 1-inch height before lifting from field.
  - b. Sod for grass pave areas shall be dense and healthy, grown on a sand bed thin cut and washed.
  - c. Sod shall be dark green in color, relatively free of thatch, free from disease, weeds and harmful insects.
  - d. Sod shall be reasonably free of objectionable grassy and broadleaf weeds. Sod shall be considered weed free if no more than 2 such weeds are found per 100 square feet of sod.
  - e. Sod shall be rejected if found to contain the following weeds: common Bermuda grass, quack grass, Johnson grass, nimble weed, thistle, bindweed, bentgrass, perennial sorrel, and brome grass.
  - f. Sod variety shall be:
    - 1) Turf Grass: Tiffway II, Bullseye, Bandera, GN1, Medallion Plus 90% Tall Fescue/10% Bluegrass Blend, as produced by West Coast Turf / Pacific Sod.
    - 2) Molate Fescue: No Mow Fine Fescue Blend, as produced by Pacific Sod.
2. Lawn Seed:
  - a. Turf Grass: Seed mix shall consist of 90% Shortstop II Dwarf Fescue and 10% Nustar Kentucky Bluegrass at the rate of 523 lbs. /acre.
  - b. Molate Fescue:
    - 1) Molate fescue shall be a mixture consisting of:
      - (a) 33% Festuca Rubra 'Molate'.
      - (b) 33% Mokolumne Fescue.
      - (c) 33% Sheep Fescue.
      - (d) Seed Rate is 2.0 lbs. /1,000 sf.
  - c. Fertilizer: Combination of 16-20-20 and "Endure" 15-15-15 at a rate of 5 lbs. /sf.
  - d. Fiber: Hydro blanket at 60 lbs. /1,000sf.

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- e. As indicated on Contract Drawings.
- 3. Stolons
  - a. Tiffway II - as produced by West Coast Turf.
  - b. Bullseye - as produced by West Coast Turf.
  - c. Bandera - as produced by West Coast Turf.
  - d. GN1 - as produced by West Coast Turf.
  - e. Medallion Plus - as produced by Pacific Sod.
  - f. No mow Fine Fescue - as produced by Pacific Sod.
  - g. Furnish binder, fertilizer and amendments per soils report and stolon manufacturing recommendations.

## 2.06 MISCELLANEOUS LANDSCAPE MATERIALS:

- A. Tree Grates
  - 1. Tree Grates and Frames: ASTM A 48/A 48M, Class 35 (Class 250) or better, gray-iron castings and ASTM A 36/A 36M steel-angle frames of shape, pattern, and size indicated; steel frames hot-dip galvanized.
  - 2. Shape and Size: As indicated on drawings.
  - 3. Finish: As indicated on Plans.
  - 4. Color: As indicated on drawings.
- B. Tree Stakes: Provide stakes of sound new lodgepole pine 2" minimum diameter with minimum height, as indicated on Contract Drawings. Stakes shall have been treated with copper naphthanate or ACQ (alkaline) or Ca-B (copper azole) to a minimum wood depth of 1/16". All stakes shall be free of knots larger then 1/2" in diameter, holes and other defects.
- C. Tree Straps: Provide VIT black tree straps. Tree straps shall be attached to tree stake as shown in staking detail on the plans, color to be black.
  - 1. VIT "Cinch-tie" for 24-inch box size and smaller tree.
  - 2. VIT "Cinch-Belt" for 36-inch box size and larger tree.
- D. Vine Ties: Plastic vine ties, as specified on plans.
- E. Guying Materials
  - 1. At On-Grade Planting:
    - a. Guy Wire: No. 9 gage, galvanized, twisted clothesline type.
    - b. Anchor System: Duckbill Earth Anchor System, as manufactured by Fore Site Products, Inc.
      - 1) Box trees, sizes 24-inch box to 48-inch box: Model 68 DTS.
      - 2) Box trees, sizes 60-inch and larger: Model 88 DTS.
    - c. Hose: White neoprene hose, 3/4-inch diameter, covering the entire length of wire.
  - 2. At Raised Planters:
    - a. Guy Wire: No 9 gage, galvanized, twisted clothesline type.
    - b. Anchors for Holding Guys: 1-inch galvanized eyebolt with lead expansion shield.
    - c. Hose: White neoprene hose, 3/4-inch diameter, covering the entire length of wire.
  - 3. Turnbuckle: galvanized steel type.
    - a. 3/8 inches by 3 inches long for Model 68 DTS
    - b. 3/8 inches by 6 inches long for Model 88 DTS
  - 4. At Tree Grates
    - a. Anchor System: Duckbill Earth Anchor System, as manufactured by Fore Site Products, Inc.
      - 1) Box trees, sizes 24-inch box to 72-inch box: Model 68 RBK.
      - 2) Box trees, sizes 84-inch and larger: Model 88 RBK
- F. Headerboards And Edging
  - 1. Wood Polymer Headerboard:
    - a. All wood used shall be "Trex" or "EPIC Plastics" wood-polymer lumber.
    - b. Headerboards shall be:

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- c. 2" x 6" (for straight runs and smooth curves)
  - d. Splices shall be made with 1" x 6" not less than 12" in length.
  - e. Stakes shall be made with 1" x 3" x 16" or 1" x 2" x 18".
  - f. 1¼", #8 plated deck screws.
  - g. Refer to manufacturer's literature for product handling and installation.
  - h. Backing at splices, 1" x 4".
- 2. Concrete edger: Dimension as specified on plans, poured in place concrete edger, color per plan.
- 3. Steel Edge Restraint for Decomposed Granite Walk or Landscape Areas: Available Manufacturers and Products: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
  - a. Pave Tech, Inc.
  - b. J.T. Ryerson & Son, Inc. Or equal (no known equal).
    - 1) Material: Steel.
    - 2) Size: 1/4" x 5".
    - 3) Color: Black.
    - 4) Stakes: 4 foot maximum spacing.
    - 5) Wood: Rough construction heart redwood, 12-foot minimum length, free from knots and splits. Provide 2 by 4 for straight sections and three laminations of ¼-inch material for curved sections.
    - 6) Stakes: 1 by 2 by 18-inch construction heart redwood, bevel cut.
    - 7) Scabs: 1 by 4 by 4-feet long construction heart redwood.
    - 8) Nails: Common, galvanized, 16d.
    - 9) Splices: 1 by 4 by minimum 24-inches long.
- 4. Aluminum Edge Restraint for Decomposed Granite Walk or Landscape Areas:
  - a. Cleanline as manufactured by Permaloc Corporation.
    - 1) Color and Finish: Black anodized finish.
    - 2) Stakes: 12 inch long aluminum
- G. Mulch
  - 1. River Cobble Mulch: Washed River Cobble blend consisting of x-x" diameter cobbles. Place 8 inch minimum depth and extend 6" either side beyond weed control fabric edge.
  - 2. Rock Mulch: As indicated on drawings. All 3/8-inch "xxxxx" aggregate rock mulch shall be washed twice by Contractor and shall be clean prior to installation.
  - 3. Bark Mulch:
    - a. Mulch shall be shredded bark mulch, as manufactured by Whittier Fertilizer, Pico Rivera, CA.
      - 1) Mulch shall consist of shredded bark mulch with a particle range of 2-3/4-inch to 1-inch in size.
    - b. Mulch shall be Walk-On Bark
      - 1) As available from Redi-Grow Corporation, Sacramento, CA.
- H. Weed Control Fabric: Place Mirafi Mirascape landscape fabric below rock mulch or as shown on drawings. Overlap all seams 12" minimum and pin down every 36" typical. Mirascape fabric available from: Towns & Associates, 800-222-6036
- I. Root Control Barriers: High-density polypropylene root control planter. Acceptable products include:
  - 1. Deep Root; Deep Root Corporation.
  - 2. Size as specified on drawings.
- J. Drainage Materials
  - 1. Gravel in raised planters on structural slab and in pots shall be clean, coarse 3/8-inch to 3/4-inch diameter.
  - 2. Gravel for tree drainage shall be 3/4" diameter coarse clean gravel.

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3. Synthetic filter membrane cover over drainage course shall be woven synthetic fabrics.
    - a. Model 140N, as manufactured by Mirafi.
  4. Drain Pipe at trees: 4-inch diameter PVC perforated(within gravel), and non-perforated PVC drain pipe(stand pipe) with PVC adaptor connected to 4-inch ABS female reciever with 4-inch black ABS cleanout plug.
- K. Sand: Washed plaster sand.
- L. Jute Netting: A uniform open plan weave, single jute yarn not varying in thickness by more than 1/2 of its normal diameter, in rolled strips approximately 50 to 75 yards long and 50 to 60 inches wide. Contractor shall submit sample for approval prior to installation.
- M. Staples: 11 gage with 1-inch top and 6-inch legs.
- N. Sod Pegs: 1-inch square by 6-inch long pine or 6-inch lengths of lath.
- O. Weed Control: Phydura, or equal.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected, and Architect has reviewed and accepted materials as defined within the section.

#### **3.02 SITE OBSERVATION SCHEDULE**

- A. General: Notify Architect at least 5 days in advance when requesting on-site reviews.
- B. Prior to commencement of site visits, items noted in previous observation reports shall have been either completed or remedied, unless such compliance has been waived. Failure to complete prior tasks or failure to prepare adequately for scheduled observations shall obligate Contractor to reimburse Architect for additional hourly services, plus transportation costs
- C. Schedule For On-Site Reviews by the Landscape Architect:
  1. Pre-construction conference with general contractor, grading contractor, landscape contractor, project arborist and landscape architect to discuss grading and protective measures to be followed in the vicinity of existing trees, or existing structures.
  2. Review of soil sampling and fine grading prior to installation of any planting material.
  3. At completion of finish grading, and roto-tilling
  4. Review of irrigation coverage prior to installation of any planting material.
  5. At completion of fine grading and at delivery of plant materials, together with plant layout; prior to excavating pits.
  6. Review of drainage system, standpipes, and plant material locations.
  7. After planting pits have been excavated, but prior to backfilling. Provide one sample plant pit mock up for review.
  8. After initial planting operations (One tree with each type of specified staking shall be approved prior to planting of trees).
  9. Stake all tree locations for review.
  10. See "Final Review and Acceptance" at the end of Part 3 in this Section for final site observations and acceptance of work.

#### **3.03 TESTING**

- A. Planting Soil: Agronomic Soil Testing
  1. Test shall be paid for by the Contractor. Testing lab shall be:
    - a. Wallace Labs, El Segundo, CA
    - b. Soil and Plant Labs, Orange, CA
    - c. Sunland Analytical Labs, Rancho Cordova, CA
    - d. Soil & Plant Lab, Santa Clara, CA
    - e. Agronomic Soils Testing

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- 1) Take six samples of site soil at a depth of 6 to 12 inches, within proposed planting areas, after completion of final grading and prior to weed control and soil preparation.
- 2) Take samples to agronomic soils testing laboratory indicated above for soil evaluation.
- 3) Request testing for fertility and suitability analysis with written recommendations for soil amendment, fertilizer and chemical conditioners, application rates for soil preparation, planting backfill mix, pot-soil mix, hydro-spray, and post-maintenance fertilization programs.
- 4) Soils report recommendations shall take precedence over the amendment and fertilizer application rates specified in this section.
- 5) Submit testing laboratory's interpretation, recommendations, and comments to Architect within 14 days after the completion of rough grading.
- f. Furnish a soils analysis of import soil, and organic soil amendment prior to backfill.
  - 1) Submit soil testing laboratory's findings to Architect within 5 days prior to backfilling.
- g. Take six additional soil samples after completion of planting in the soil preparation and backfill mix areas, to be determine effectiveness to amendments prior and during planting. Submit to the testing laboratory the original amendment specification with previously issued bulletins for soil amendments and installation procedures. Re-apply necessary amendments based on recommendation of new soils test.

### 3.04 PREPARATION

#### A. Final Grades

1. Finished grading shall insure proper drainage of the site. Conform to Division 31 Section "Earthwork" and Division 32 Section "Landscape Grading."
2. The following areas shall be graded so that the final grades shall be established below adjacent paved areas, sidewalks, valve boxes, headers, clean outs, drains, manholes, etc. before placement of mulch as follows:
  - a. Shrub/Groundcover Areas: 2-1/2 inches.
  - b. Turf areas: 1-inch.
  - c. Surface drainage shall be away from all building foundations, 2% minimum.
  - d. Dispose of excess or unacceptable soil from the site at no expense to the Owner.
  - e. Verify that final grades have been established prior to beginning planting operations.
3. Parking Lot Planters and areas adjacent to hardscape.
  - a. All aggregate base rock, lime-treated soil, soil sterilents, and other non-organic materials shall be removed from all parking lot planter areas down to the level of native soil. Scarify native soil to a depth of 12 inches and backfill planters to specified finish grade with native or approved topsoil and amend as specified.
  - b. Remove all concrete overpours or any material that may prohibit the placement of plant material, irrigation, grates, root barriers, or any other conflicting material.
4. Lightweight soil mix shall be sampled after mixing and delivery to the site, but prior to filling planters. Submit the original lightweight soil specification to the testing laboratory with previous bulletins for lightweight soil mix. Provide 1-quart of lightweight soil mix for every 65 cubic yards for organic and fertility analyses. Fertility analysis, recommendations and interpretations shall be furnished by the testing laboratory to ensure all specified amendments have been provided. Lightweight soil is to be used only in locations indicated on the Contract Drawings and as approved by the Architect.
5. Protect planting areas from compaction by foot, trucks and heavy equipment.

### 3.05 PLANTING BED ESTABLISHMENT

#### A. Preparation Of Planting Area

1. Cross-rip on-grade planting areas to a minimum depth of 12 inches minimum 2 perpendicular directions. Remove stones over 1/2 inch (13mm) in any dimension and sticks, roots, rubbish and other deleterious matter per Division 32 "Landscape Grading".

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2. Where additional soil is needed, place the top 15" with topsoil. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil.
3. Leach soil prior to amending.
4. After approximate finished grades have been established and soil has been leached, soil shall be conditioned and fertilized in the following manner: Soil condition shall, at the rate specified in the approved soils test recommendations, be uniformly spread and cultivated thoroughly by means of mechanical tiller into the top eight inches (6") of soil.
5. Broadcast soil amendments uniformly over surface of the area to be treated. Roto-till the top eight inches (6") of planting areas to evenly distribute the amendments and conditioners into the soil.
6. Retest as required to verify leaching was successful. All soil areas shall be compacted and settled by application of irrigation to a minimum depth of six (6) inches prior to any plant materials being installed.
7. At time of planting, the top 8 inches of all areas to be planted shall be free of stones, stumps, or other deleterious matter one 1/2 inch in diameter or larger, and shall be free from all debris, or similar objects that would be a hindrance to planting and maintenance.
8. Weed Eradication:
  - a. Manually remove all existing vegetation in planting areas and dispose of it offsite.
  - b. Fertilize planting areas with urea 30-0-0 commercial fertilizer at the rate of 0.5 pounds per 1000 square feet.
  - c. Water planting areas thoroughly and continuously (by irrigation system, hand/hose, water truck, or other) for a period of 3 consecutive weeks, or until the weed seed have germinated. As accepted in advance by the Landscape Architect, employ a specific watering duration and frequency program designed to germinate residual weed seeds.
  - d. Discontinue watering process for 2 days. Then apply a non-selective broad spectrum systemic herbicide for perennial weeds. (applications minimum) The type of herbicide to be used shall be determined by a licensed pest control applicator. If annual weeds are present, use straight contact herbicide in accordance with pest control applicator's recommendations.
    - 1) Do not use a pre-emergent herbicide.
  - e. Allow sufficient period of time to ensure that weeds are dead. Follow herbicide manufacturer's directions.
  - f. Water planting areas thoroughly and continuously (by irrigation system, hand/hose, water truck or other) for a period of 3 weeks. A shorter watering period may be permissible at the discretion of the Landscape Architect. Discontinue watering process for 1 day prior to the second application of the herbicide spraying. (2 applications minimum) Re-apply the spraying operation with straight contact weed killer in accordance with pest control adviser's recommendations.
    - 1) Do not use a pre-emergent herbicide.
    - 2) Avoid irrigation for a minimum of 4 days for effective final weed kill.
  - g. Clear desiccated weeds from the area.
  - h. Water Planting areas thoroughly and continuously for 3 consecutive days to saturate upper layers of soil prior to planting operations.
  - i. Allow planting area soil surface to dry out for 1 day only prior to the planting application. Exercise care to not allow the soil surface to be either super-saturated with water or bone dry prior to the planting installation. Ensure moderate residual moisture within the top 1/4 inch of the soil surface.
  - j. The hydraulic equipment used for pesticide applications shall consist of an ISO-gallon minimum capacity fiberglass tank with complete mechanical agitation. The pump capacity shall be 10 gallons per minute while operating at a pressure of 100 pounds. Per square inch.
  - k. Distribution lines shall be large enough to carry the volume of water necessary for even, chemical distribution. The spray nozzle must cover a 15-foot swath, with a minimum output of 5 gallons per minute at 80 pounds per square inch.

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9. Pre-emergent Weed Control: Immediately after planting, apply pre-emergent weed control to planted areas which will not be seeded.
10. Excavation For Trees And Shrubs
  - a. Excavate pits, beds, and trenches as shown in details on the drawings.
11. Preparation for Lawn Areas: Limit preparation to areas which will be planted promptly after preparation.
  - a. Prepare planting area as described in 3.05 A.
  - b. Fine grade lawn areas to smooth, even surface with loose, uniformly fine texture. Roll, rake and drag lawn areas, remove ridges and fill depressions, as required to meet finish grades. Establish smooth uniform surface. Limit fine grading to areas which can be planted immediately after grading.
  - c. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.
12. Restore lawn areas to specified conditions if eroded or otherwise disturbed after fine grading and prior to planting.

### **3.06 BIOFILTRATION PLANTER SOIL**

- A. The Biofiltration planter soil shall be placed on the planter area and firmed to a depth of as shown on the drawings. Mix shall be moist when spread to discourage migration in to the subgrade and to assist forming.
- B. Soil mix shall be separated from drainage courses with geotextile fabric equal to Mirafi 140N.
- C. See Grading Plans for locations and depths and Planting plans for plant material.

### **3.07 ROOTZONE FOR SAND BASED TURF**

- A. The thoroughly mixed root zone material shall be placed on the areas designated for turf (except for areas designated for grass pavers) and firmed to a uniform depth of 6 inches (300mm) with a tolerance of +1/4-inch (6mm). Mix shall be moist when spread to discourage migration in to the subgrade and to assist forming.
- B. Soil mix shall be separated from drainage courses with geotextile fabric equal to Mirafi 140N.
- C. See Planting Plans for turf locations.

### **3.08 PLANTING**

- A. General
  1. Actual planting shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted practice, as approved by the Architect.
  2. Only as many plants as can be planted and watered on that same day shall be distributed in a planting area.
  3. Container shall be opened and plants shall be removed in such a manner that the ball of earth surrounding the roots is not broken and they shall be planted and watered as herein specified immediately after removal from the containers. Containers shall not be opened prior to placing the plants in the planting area.
- B. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure acceptance by the Architect before start of planting work. Make minor adjustments as may be requested.
- C. Excavation for Trees and Shrubs:
  1. Excavate pits, beds and trenches as shown in details on the Drawings.
  2. Roughen and score edges of planting pit to eliminate any glazing of the sides of the pit.
  3. Field Samples: Prior to planting, prepare one plant pit with standpipe, gravel, filter fabric, and root barriers for each tree size to be reviewed by the Architect.
  4. Do not cover standpipes.
  5. Excavation for planting shall include the stripping and stockpiling of all acceptable topsoil encountered within the areas to be excavated for trenches, tree pits, plant pits, and planting beds.

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D. Container Removal

1. Cut containers on two sides with an acceptable cutter. Do not cut containers with spade or ax. Do not injure the rootball.
2. Carefully remove plants from containers without injury or damage to rootball.
3. After removing plants, superficially cut edge roots with knife on three sides.
4. For plants with sensitive roots, place container intact in flat pit 1½ times the size of a standard plant pit. Insert blades of sharp, needle-nose shears into a drain hole and cut the container bottom away. Remove bottom from pit. Follow with a cut down one side of the container from top to bottom. Repeat cut on opposite side. Fill plant pit with prepared plant pit mixture. Carefully remove the detached pieces.

E. Box Removal:

1. Remove bottom of planting boxes before planting.
2. Remove sides of box without damage to rootball after positioning plant and partially backfilling.

F. Planting Trees and Shrubs: Set container-grown stock, plumb and in center of pit or trench. Set top of rootball 2-inches above finish grade at trees, 1-inch above finish grade at shrubs, or as indicated on Contract Drawings. Do not use plant, if root system has severely kinked or circling roots, or if rootball is cracked, disturbed or broken. If root system is healthy, loosen spiraling roots and set in plant pit.

G. Planting pit shall be backfilled with the following soil conditioner and organic amendment, per cubic yard:

1. Application Rates, (below are for bid purposes only) as determined by contractor's soils tests:
  - a. Potassium Sulfate - 0-0-50, ¼-pound
  - b. Single Superphosphate - 0-20-0, ¼-pound
  - c. Ammonium Sulfate - 21-0-0, ¼-pound
  - d. Compost - 15% by volume
  - e. Agricultural Gypsum - 1.5 pounds
  - f. Good Humus - 15% by volume
2. Final amendments to be determined by Agronomic Soils Test.

H. When set, place additional fill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 1/2-full, place appropriate number of fertilizer tablets and complete backfill operations.

I. After backfilling, an earthen basin shall be constructed around each plant. Each basin shall be as indicated on the Contract Drawings. Basin shall be of a size suitable for the individual plant. In no case shall the basin for fifteen (15) gallon plant be less than four (4) feet in diameter; a five (5) gallon plant less than three (3) feet in diameter. The basins shall be constructed of amended backfill materials, and shall not be constructed for trees in turf areas.

J. Repeat watering until no more is absorbed.

K. Apply pre-emergent herbicide as per manufacturer's recommendations to all shrub and ground cover planting areas after planting.

L. Mulch all planted areas that do not receive jute netting, other than lawn areas, at not less than 2" thickness of mulch.

1. Areas greater than 30% slope shall be protected with jute mesh.

M. Equally space and align trees and shrubs in both directions where designated on Contract Drawings.

N. Pull bark mulch away from the rootballs of all plants to insure proper air circulation.

O. Prune, thin out and shape trees and shrubs in accordance with standard horticultural practices. Prune trees and other plantings only if required. Pruning shall be limited to remove injured wigs and branches, and to compensate for loss of roots during transplanting, but never exceed 1/3 of the branch structure. Never prune without prior review with Architect.

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- P. Prune shrubs to retain natural character. Unless directed by the Architect, do not prune leaders or apices of any plant material. Do not prune into balled or boxed forms without prior written approval of the Architect.
- Q. Remove and replace excessively pruned or malformed stock resulting from improper pruning.
- R. Planting Ground Cover
  - 1. Space plants as shown or scheduled.
  - 2. Dig holes large enough to allow for spreading of roots and compact area around plant. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not to cover crowns of plants with wet soils.
  - 3. Mulch areas between ground cover plants with not less than 2" deep mulch.
- S. Miscellaneous Landscape Work: Install headers and edgings where shown. See appropriate details. Install 5" minimum layer of gravel, where shown, as specified in Section 2.04, compacted and leveled to fill voids at areas around building as shown on drawings.
- T. Planting Vines: Plant in accordance with Section 3.06. Attach vine to columns with vine ties as per manufacturer's recommendations.
- U. Tree Staking and Guying: Stake or guy all trees per landscape details, and tie with tree ties as specified. Remove all nursery stakes from trees unless directed otherwise by the Architect. Immediately after planting, stake and guy all trees in accordance with details indicated on Contract Drawings. One tree of each size shall be staked and guyed, and reviewed by Architect prior to continue work.
- V. Hardpan Conditions
  - 1. Where hardpan exists, whether it is in the form of caliche, rock or other impervious matter, and it is within the top 2½ feet of soil, or within the plant pit, use powered equipment to break through completely at each plant location to allow drainage and root growth. Remove hardpan at least 1½ feet greater than the rootball diameter of plant. Backfill with soil mix as specified.
  - 2. Where hardpan is within the first 12-inches of soil, it shall be completely penetrated for all trees and shrubs.

### **3.09 CLEANUP AND PROTECTION:**

- A. During landscape work, keep pavements clean and work area in an orderly condition. Haul away and remove all debris from landscape areas, and do not leave any clippings, and or other material from landscape planting and/or maintenance period.
- B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and/or other trades. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscape work as directed.
- C. Powerwash all pavement and flatwork as necessary to remove all staining and tire marks and provide a clean surface.

### **3.10 FINAL REVIEW & ACCEPTANCE**

- A. General: Notify Architect at least 5 days in advance when requesting on-site reviews.
- B. Final Site Observation requirements:
  - 1. Punch list at substantial completion.
  - 2. Final review of grading, irrigation and planting (to begin Maintenance Period).
  - 3. Final acceptance of project (at end of Maintenance Period).
  - 4. Refer to Division 32 Section "Landscape Maintenance."
  - 5. The maintenance period will not begin until all punchlist items are resolved and acceptance is provided by the architect in writing.

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6. Where observed work does not comply with the Plans and Specifications, replace rejected work and continue specified maintenance period until reinspected by the Landscape Architect and determined to be acceptable. All replacement materials and installations shall be in accordance with the Plans and Specifications. Remove rejected work and materials immediately from project. Prior to the date of final observation, Contractor shall provide the Landscape Architect with all Record Drawings in accordance with the Plans and Specifications.

### **3.11 GUARANTEE AND REPLACEMENT**

- A. Guarantee: All plant material and other materials installed under the Contract shall be guaranteed against any and all poor, inadequate or inferior materials and/or workmanship or improper maintenance, as determined by the Landscape Architect, and shall be replaced by the Contractor at his expense. Warranty periods are as follows:
  1. Trees, vines, and shrubs: One Year
  2. Groundcover and Turf: One Year
  3. Replacement: Any materials found to be dead, missing, or not in a satisfactory or healthy condition during the maintenance period shall be replaced immediately. The Landscape Architect shall be sole judge as to the condition of material. Material to be replaced within the guarantee period shall be replaced by the Contractor within five (5) days of written notification by the Landscape Architect. All replacement materials and installations shall comply with the Plans and Specifications. Any plant missing due to suspected theft shall be replaced by the Contractor. If the Contractor suspects that theft may be a problem, the Contractor shall provide written documentation to the Landscape Architect that security on this site needs to be intensified.
  4. The Contractor may relieve himself of theft responsibility if after the security notice, with no result, a written notice to the Landscape Architect shall be given that plant material will not be replaced for theft or vandalism due to lack of site security being maintained. This procedure may take place only during the Landscape Maintenance Period.

**END OF SECTION 32 9300**

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## SECTION 33 1416 SITE WATER UTILITY DISTRIBUTION PIPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Water pipe for site conveyance lines.
- B. Pipe and fittings for site water lines including domestic water lines and fire water lines.
- C. Valves, Fire hydrants, and Domestic water hydrants.
- D. Pipe valves.
- E. Fire hydrants.

#### 1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete for thrust restraints.
- B. Section 09 9113 - Exterior Painting.
- C. Section 21 1100 - Facility Fire-Suppression Water-Service Piping.
- D. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
- E. Section 31 2323 - Fill: Bedding and backfilling.

#### 1.03 REFERENCE STANDARDS

- A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- C. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- D. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- E. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- F. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- G. 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.
- H. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- I. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
- J. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
- K. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
- L. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- M. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings.
- N. AWWA C115/A21.15 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
- O. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast.
- P. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
- Q. AWWA C502 - Dry-Barrel Fire Hydrants.
- R. AWWA C504 - Rubber-Seated Butterfly Valves.

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- S. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 48-In. (50-mm Through 1,200-mm) NPS.
- T. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
- U. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances.
- V. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm).
- W. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 3/4 In. (19 mm) Through 3 In. (76 mm), for Water Service.
- X. UL 246 - Hydrants for Fire-Protection Service.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.

#### **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.

### **PART 2 PRODUCTS**

#### **2.01 WATER PIPE**

- A. Ductile Iron Pipe: AWWA C151/A21.51:
  - 1. Fittings: Ductile iron, standard thickness.
  - 2. Joints: AWWA C111/A21.11, Styrene butadiene rubber (SBR) or vulcanized SBR gasket with rods.
  - 3. Jackets: AWWA C105/A21.5 polyethylene jacket.
- B. Copper Tubing: ASTM B88, Type K, Annealed:
  - 1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
  - 2. Joints: Compression connection or AWS A5.8M/A5.8, BCuP silver braze.
- C. PVC Pipe: ASTM D1785 Schedule 40.
  - 1. Fittings: ASTM D2466, PVC.
  - 2. Joints: ASTM D2855, solvent weld.
- D. PVC Pipe: AWWA C900 Class 100:
  - 1. Fittings: AWWA C111/A21.11, Schedule 40 per ASTM D2466 or schedule 80 per ASTM D2467.
  - 2. Joints: ASTM D3139 compression gasket ring.
- E. Polyethylene Pipe: AWWA C901:
  - 1. Fittings: AWWA C901, molded or fabricated.
  - 2. Joints: Compression.
- F. Detectable Warning Tape: Per Section 312316.13.

#### **2.02 VALVES**

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Gate Valves Up To 3 Inches:
  - 1. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, compression ends, with control rod, post indicator, valve key, and extension box.
- C. Gate Valves 3 Inches and Over:
  - 1. AWWA C500, iron body, bronze trim, non-rising stem with square nut, single wedge, flanged ends, control rod, post indicator, valve key, and extension box.

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- D. Ball Valves Up To 2 Inches:
  - 1. Brass body, Teflon coated brass ball, rubber seats and stem seals, Tee stem pre-drilled for control rod, AWWA inlet end, compression outlet with electrical ground connector, with control rod, valve key, and extension box.
- E. Swing Check Valves From 2 Inches to 24 Inches:
  - 1. AWWA C508, iron body, bronze trim, 45 degree swing disc, renewable disc and seat, flanged ends.
- F. Butterfly Valves From 2 Inches to 24 Inches:
  - 1. AWWA C504, iron body, bronze disc, resilient replaceable seat, water or lug ends, ten position lever handle.

## **2.03 HYDRANTS**

- A. Hydrants: Type as required by utility company.
- B. 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 2316.13.
- B. Cover: As specified in Section 31 2316.13.

## **2.05 ACCESSORIES**

- A. Concrete for Thrust Restraints: Concrete type specified in Section 03 3000.
- B. Detectable Warning Tape: As specified in Section 31 2316.13.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Prior to beginning work, verify that building service connection and municipal and site 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 TRENCHING**

- A. See the section on trenching for additional requirements.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
- C. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide thrust restraint bearing on subsoil, size as indicated.
- D. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

### **3.04 INSTALLATION - PIPE**

- A. Maintain separation of water main from sewer piping in accordance with [ ] code.
- B. Install pipe to indicated elevation to within tolerance of 5/8 inches.
- C. Install ductile iron piping and fittings to AWWA C600.
- D. Route pipe in straight line.
- E. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- F. Install detectable warning tape 6 inches above top of pipe; coordinate with Section 31 2316.13.

### **3.05 INSTALLATION - VALVES AND HYDRANTS**

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- A. Set valves on solid bearing.
- B. Center and plumb valve box over valve. Set box cover flush with finished grade.
- C. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway in accordance with Section 21 1100.
- D. Set hydrants to grade, with nozzles at least 20 inches above ground in accordance with Section 21 1100.
- E. Paint hydrants as required by the local fire authority or as indicated.

### **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.

### **3.07 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Pressure test water piping as required by the local water agency.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

**END OF SECTION 33 1416**

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## SECTION 33 3113 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 onsite Campus sewer system.

#### 1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete for cleanout base pad construction.
- B. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
- C. Section 31 2323 - Fill: Bedding and backfilling.
- D. Section 33 0561 - 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 C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
- B. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- C. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
- D. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.
- E. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- F. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- G. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Material.
- H. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating pipe, pipe accessories .

### PART 2 PRODUCTS

#### 2.01 SEWER PIPE MATERIALS

- A. Provide products that comply with applicable code(s).
- B. Plastic Pipe: ASTM D3034, SDR 35, Poly(Vinyl Chloride) (PVC) material; bell and spigot style rubber gasket joints.
- C. Plastic Pipe: ASTM D1785, Schedule 40, Poly(Vinyl Chloride) (PVC) material; bell and spigot style solvent sealed joint end.
- 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.

#### 2.02 PIPE ACCESSORIES

- A. Detectable warning tape: As specified per Section 312316.13.

#### 2.03 MANHOLE

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- A. Lid and Frame: Cast iron construction.
- B. 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.
- C. Base Pad: Cast-in-place concrete of type specified in Section 03 3000, 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 2316.13.
- B. Pipe Cover Material: As specified in Section 31 2316.13.

## **PART 3 EXECUTION**

### **3.01 GENERAL**

- A. Perform work in accordance with applicable code(s).

### **3.02 EXAMINATION**

- A. Prior to beginning work, verify that building service connections, municipal and site storm main size, location, and invert are as indicated.

### **3.03 TRENCHING**

- A. See Section 31 2316.13 for additional requirements.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
- C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

### **3.04 INSTALLATION - PIPE**

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
  - 1. Plastic Pipe: Also comply with ASTM D2321.
- C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Connect to building sanitary sewer outlet and municipal sewer system, through installed sleeves.
- E. Install detectable warning tape 6 inches above top of pipe; coordinate with Section 31 2316.13.

### **3.05 INSTALLATION - CLEANOUTS**

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections.
- C. Establish elevations and pipe inverts for inlets and outlets as indicated.
- D. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

### **3.06 FIELD QUALITY CONTROL**

- A. Perform field inspection and testing in accordance with Section 01 4000.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- C. Pressure Test: Test in accordance with [\_\_\_\_\_].

### **3.07 PROTECTION**

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- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

**END OF SECTION 33 3113**

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## SECTION 33 4211 STORMWATER GRAVITY PIPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Storm drainage piping, fittings, and accessories.
- B. Connection of drainage system to onsite Campus drainage system.
- C. Catch basins, Plant area drains, and Paved area drainage.

#### 1.02 RELATED REQUIREMENTS

- A. Section 31 2316 - Excavation: Excavating of trenches.
- B. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
- C. Section 31 2323 - Fill: Bedding and backfilling.

#### 1.03 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

#### 1.04 REFERENCE STANDARDS

- A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.
- B. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.
- C. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- D. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
- E. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- F. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- G. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
- H. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- I. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- J. Standard Specifications for Public Works Construction (Greenbook); current edition.

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating pipe, pipe accessories, and other drain components as indicated.
- C. Field Quality Control Submittals: Document results of field quality control testing.
- D. Project Record Documents:
  - 1. Record location of pipe runs, connections, catch basins, cleanouts, and invert elevations.
  - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

### PART 2 PRODUCTS

#### 2.01 STORM DRAINAGE PIPE MATERIALS

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- A. Plastic Pipe: ASTM D3034, Type PSM, Poly Vinyl Chloride (PVC) material; bell and spigot style solvent sealed joint end.
- B. Cast in Place Concrete: Per Section 03 3000.

## **2.02 PIPE ACCESSORIES**

- A. Pipe Joints: Mechanical clamp ring type, stainless steel expanding and contracting sleeve, neoprene ribbed gasket for positive seal.
- B. 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.
- C. Detectable Warning Tape: As specified per Section 312316.13.

## **2.03 BEDDING AND COVER MATERIALS**

- A. Bedding: As specified in Section 31 2316.13.
- B. Cover: As specified in Section 31 2316.13.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Prior to beginning work, verify that building service connection and municipal and site utility water main size, location, and invert are as indicated.

### **3.02 TRENCHING**

- A. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

### **3.03 INSTALLATION - PIPE**

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
  - 1. Plastic Pipe: Also comply with ASTM D2321.
- C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Connect to building storm drainage system, foundation drainage system, and utility/municipal sewer system.
- E. Install detectable warning tape 6 inches above top of pipe; coordinate with Section 31 2316.13.

### **3.04 INSTALLATION - CATCH BASINS, TRENCH DRAINS AND CLEANOUTS**

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections.
- C. Level top surface of base pad; sleeve concrete shaft sections to receive storm sewer pipe sections.
- D. Establish elevations and pipe inverts for inlets and outlets as indicated.
- E. Mount lid and frame level in grout, secured to top cone section to elevation indicated.
- F. Prefabricated trench drains:
  - 1. Excavate; prepare substrate and supports according to the manufacturer's printed installation instructions.
  - 2. Install prefabricated trench drain system according to the manufacturer's printed installation instructions.

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3. Expansion, Construction, and Control Joints: Do not locate trench drain system on an expansion, construction or control joint in concrete or pavement. Where concrete or pavement joints running transverse to direction of flow cross the trench drain system, locate concrete or pavement joints and trench drain system joints so that both coincide.
4. Concrete Trench Support: 3000 pounds per square inch compressive strength, minimum.
  - a. Provide support on all sides of trench in minimum thickness recommended by trench drain system manufacturer.
  - b. Screed and finish top edge of concrete flush with top surface of trench drain system.
  - c. Do not use secondary edge finishing tools.

### **3.05 FIELD QUALITY CONTROL**

- A. Perform field inspection in accordance with Section 01 4000 - Quality Requirements.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
  1. Pressure Test: Test in accordance with Greenbook Section 306-1.4.5.
  2. Infiltration Test: Test in accordance with Greenbook Section 306-1.4.3.

### **3.06 PROTECTION**

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

**END OF SECTION 33 4211**