

# PROJECT MANUAL



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# MOUNTAIN VIEW HIGH SCHOOL

MODERNIZATION PROJECT

A#03-122209, 19-H10

2900 Parkway Drive, El Monte

**DSA Approval**

November 14, 2022

El Monte Union High School District

LPA Project No.: 30154.10

Mountain View High School- Modernization Project  
El Monte Union High School District

LPA No. 30154.10  
DSA Approval 11/14/22

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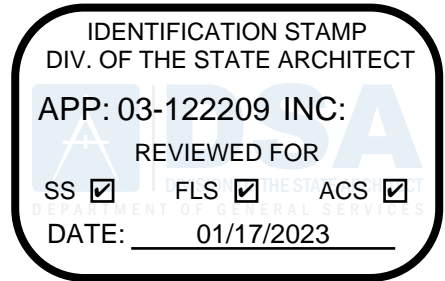
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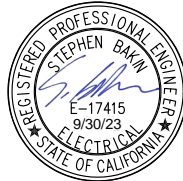


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**SECTION 011000  
SUMMARY**

**PART 1 GENERAL**

**1.01 PROJECT**

- A. Project Name: Mountain View High School- Modernization
- B. Owner's Name: El Monte Union High School District.
- C. Architect's Name: LPA Design Studios.
- D. The Project consists of the alteration of existing Building A, B, H, K, other campus wide building upgrades and site work..

**1.02 CONTRACT DESCRIPTION**

- A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 005200 - Agreement Form.

**1.03 DESCRIPTION OF ALTERATIONS WORK**

- A. Scope of alterations work is indicated on drawings.
- B. Contractor shall remove and store the following prior to start of work, for later reinstallation by Contractor:

**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. Construction Operations: Limited to areas noted on Drawings.
  - 1. Locate and conduct construction activities in ways that will limit disturbance to site.
- B. Arrange use of site and premises to allow:
  - 1. Owner occupancy.
- C. Provide access to and from site as required by law and by Owner:
  - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
  - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- D. Utility Outages and Shutdown:
  - 1. Limit disruption of utility services to hours the building is unoccupied.
  - 2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
  - 3. Prevent accidental disruption of utility services to other facilities.
- E. Nonsmoking Building: Smoking is not permitted within the building or 25 feet of entrances, operable windows, outdoor-air intakes.
- F. Controlled Substances: Use of tobacco products and other controlled substances within the existing building is not permitted.

**1.07 WORK SEQUENCE**

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A. Coordinate construction schedule and operations with Construction Manager.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**



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**SECTION 012000  
PRICE AND PAYMENT PROCEDURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Price and Contract Time.
- C. Change procedures.
- D. Correlation of Contractor submittals based on changes.
- E. Procedures for preparation and submittal of application for final payment.

**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.
- C. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.
- D. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
- E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.
- F. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.
- G. Revise schedule to list approved Change Orders, with each Application For Payment.

**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. For each item, provide a column for listing each of the following:
  - 1. Item Number.
  - 2. Description of work.
  - 3. Scheduled Values.
  - 4. Previous Applications.
  - 5. Work in Place and Stored Materials under this Application.
  - 6. Authorized Change Orders.
  - 7. Total Completed and Stored to Date of Application.
  - 8. Percentage of Completion.
  - 9. Balance to Finish.
  - 10. Retainage.
- E. Execute certification by signature of authorized officer.
- F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
- H. Submit three notarized copies of each Application for Payment.
- I. Include the following with the application:

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1. Transmittal letter as specified for submittals in Section 013000.
  2. Construction progress schedule, revised and current as specified in Section 013000.
  3. Partial release of liens from major subcontractors and vendors.
  4. Project record documents as specified in Section 017800, for review by Owner which will be returned to the Contractor.
  5. Affidavits attesting to off-site stored products.
- J. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

#### **1.04 MODIFICATION PROCEDURES**

- A. For minor changes not involving an adjustment to the Contract Price or Contract Time, Architect will issue instructions directly to Contractor.
- B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
  1. The document will describe the required changes and will designate method of determining any change in Contract Price or Contract Time.
  2. Promptly execute the change.
- C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within [ ] days.
- D. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
- E. Substantiation of Costs: Provide full information required for evaluation.
  1. Provide the following data:
    - a. Quantities of products, labor, and equipment.
    - b. Taxes, insurance, and bonds.
    - c. Overhead and profit.
    - d. Justification for any change in Contract Time.
    - e. Credit for deletions from Contract, similarly documented.
  2. Support each claim for additional costs with additional information:
    - a. Origin and date of claim.
    - b. Dates and times work was performed, and by whom.
    - c. Time records and wage rates paid.
    - d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
  3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.
- F. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- G. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Price.
- H. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- I. Promptly enter changes in Project Record Documents.

#### **1.05 APPLICATION FOR FINAL PAYMENT**

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- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Price, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
  - 1. All closeout procedures specified in Section 017000.
  - 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  - 3. Updated final statement, accounting for final changes to the Contract Sum.
  - 4. Waivers.
  - 5. Consent of Surety to final payment.
  - 6. Evidence that claims have been settled.
  - 7. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
  - 8. Final liquidated damages settlement statement.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

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**SECTION 012500  
SUBSTITUTION PROCEDURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Procedural requirements for proposed substitutions.

**1.02 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.

**1.03 REFERENCE STANDARDS**

- A. CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage) Current Edition.
- B. CSI/CSC Form 13.1A - Substitution Request (After the Bidding/Negotiating Phase) Current Edition.

**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.
- D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
  - 1. No specific form is required. Contractor's Substitution Request documentation must include the following:
    - a. Project Information:
      - 1) Official project name and number, and any additional required identifiers established in Contract Documents.
    - b. Substitution Request Information:
      - 1) Discrete and consecutive Substitution Request number, and descriptive subject/title.

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- 2) Indication of whether the substitution is for cause or convenience.
- 3) Issue date.
- 4) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
- 5) Description of Substitution.
- 6) Reason why the specified item cannot be provided.
- 7) Differences between proposed substitution and specified item.
- 8) Description of how proposed substitution affects other parts of work.
- c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
  - 1) Physical characteristics.
  - 2) In-service performance.
  - 3) Expected durability.
  - 4) Visual effect.
  - 5) Sustainable design features.
  - 6) Warranties.
  - 7) Other salient features and requirements.
  - 8) Include, as appropriate or requested, the following types of documentation:
    - (a) Product Data:
    - (b) Samples.
    - (c) Certificates, test, reports or similar qualification data.
    - (d) Drawings, when required to show impact on adjacent construction elements.
- d. Impact of Substitution:
  - 1) Savings to Owner for accepting substitution.
  - 2) Change to Contract Time due to accepting substitution.
- 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.

### **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. Owner will consider requests for substitutions only if submitted at least 10 days prior to the date for receipt of bids.

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

- A. Architect will consider requests for substitutions only within 15 days after date of Agreement.
- B. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- C. Substitutions will not be considered under one or more of the following circumstances:
  1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
  2. Without a separate written request.
  3. When acceptance will require revisions to Contract Documents.

### **3.04 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.

### **3.05 ACCEPTANCE**

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

**3.06 CLOSEOUT ACTIVITIES**

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

**END OF SECTION**

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**SECTION 013000  
ADMINISTRATIVE REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 RELATED REQUIREMENTS**

- A. Section 016000 - Product Requirements: General product requirements.

**1.03 REFERENCE STANDARDS**

**1.04 GENERAL ADMINISTRATIVE REQUIREMENTS**

- A. Comply with requirements of Section 017000 - 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.

**1.05 PROJECT COORDINATOR**

- A. Project Coordinator: Construction Manager.
- B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for construction access, traffic, and parking facilities.
- C. During construction, coordinate use of site and facilities through the Project Coordinator.
- D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities. Responsibility for providing temporary utilities and construction facilities is identified in Section 011000 - Summary.

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- F. Coordinate field engineering and layout work under instructions of the Project Coordinator.
- G. Make the following types of submittals to Architect through the Project Coordinator:

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 ELECTRONIC DOCUMENT SUBMITTAL**

- 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. It is Contractor's responsibility to submit documents in allowable format.
  - 3. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
  - 4. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. 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. Project Coordinator will schedule a meeting after Notice of Award.
- B. Attendance Required:
  - 1. Owner.
  - 2. Architect.
  - 3. Contractor.
  - 4. Construction Manager.
- 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 .
  - 7. Procedures and processing of field decisions, RFIs, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
  - 8. Scheduling.
  - 9. Scheduling activities of a Geotechnical Engineer.
  - 10. Phasing.
  - 11. Critical work sequencing and long-lead items.
  - 12. Labor law requirements, including payment and reporting requirements.
- 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.

**3.03 SITE MOBILIZATION MEETING**

- A. Project Coordinator will schedule meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required:



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1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Major subcontractors.

C. Agenda:

1. Use of premises by Owner and Contractor.
2. Owner's requirements.
3. Work restrictions.
4. Work hours.
5. Construction facilities and controls provided by Owner.
6. Temporary utilities provided by Owner.
7. Survey and building layout.
8. Procedures for disruptions and shutdowns.
9. Parking availability.
10. Office, work, and storage areas.
11. Equipment deliveries and priorities.
12. First aid.
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. Project Coordinator will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

B. Attendance Required:

1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Major subcontractors.

C. Agenda:

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

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- 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.

### **3.05 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. Owner's partial occupancy requirements.
    - f. Installation of Owner's furniture, fixtures, and equipment.
    - g. 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 013216**

### **3.07 COORDINATION DRAWINGS**

- A. Provide information required by Project Coordinator for preparation of coordination drawings.
- B. Review drawings prior to submission to Architect.

### **3.08 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 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 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 in a format and with content acceptable to Owner.
  3. Prepare using software provided by the Electronic Document Submittal Service.
  4. 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.

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1. Include in each request Contractor's signature attesting to good faith effort to determine from 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 - 016000 - 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).
  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, 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.
  4. Highlight items for which a timely response has not been received to date.
  5. Identify and include improper or frivolous RFIs.
- 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.
1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.
- 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.

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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.

### 3.09 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 - 013216 - 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.

### 3.10 REQUESTS FOR INFORMATION (RFIS)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
  1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
  2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
  1. Project name.
  2. Project number.
  3. Date.
  4. Name of Contractor.
  5. Name of Architect.
  6. RFI number, numbered sequentially.
  7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

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- C. RFI Forms: AIA Document G716, Form bound in Project Manual, or Software-generated form with substantially the same content as indicated above, acceptable to Architect].
  - 1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
  - 1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  - 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
  - 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012200 "Price and Payment Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
  - 1. Project name.
  - 2. Name and address of Contractor.
  - 3. Name and address of Architect.
  - 4. RFI number including RFIs that were returned without action or withdrawn.
  - 5. RFI description.
  - 6. Date the RFI was submitted.
  - 7. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

### 3.11 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
  - 1. Product data.
  - 2. Shop drawings.
  - 3. Samples for selection.
  - 4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 017800 - Closeout Submittals.

### 3.12 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
  - 1. Design data.
  - 2. Certificates.
  - 3. Test reports.

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4. Inspection reports.
5. Manufacturer's instructions.
6. Manufacturer's field reports.
7. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner.

### 3.13 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 017800 - Closeout Submittals:
  1. Project record documents.
  2. Operation and maintenance data.
  3. Warranties.
  4. Bonds.
  5. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

### 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.
- B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
  1. After review, produce duplicates.
  2. Retained samples will not be returned to Contractor unless specifically so stated.

### 3.15 SUBMITTAL PROCEDURES

- A. General Requirements:
  1. Use a separate transmittal for each item.
  2. Transmit using approved form.
    - a. Use Contractor's form, subject to prior approval by Architect.
  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. Send submittals in electronic format via email to Architect.
  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.
    - c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.
  8. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.

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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.
  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. Submit concurrently with related shop drawing submittal.
  4. 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 Contract Documents and coordinating related work.
  2. Do not reproduce Contract Documents to create shop drawings.
  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.
  3. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each item image.
- 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. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect 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. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- H. 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.

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1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.
- D. Architect's and consultants' actions on items submitted for review:
1. Authorizing purchasing, fabrication, delivery, and installation:
    - a. "Approved", or language with same legal meaning.
    - b. "Approved as Noted, Resubmission 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.
      - 1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
      - 2) Non-responsive resubmittals may be rejected.
  2. Not Authorizing fabrication, delivery, and installation:
    - a. "Revise and Resubmit".
      - 1) Resubmit revised item, with review notations acknowledged and incorporated.
      - 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**



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**SECTION 013216  
CONSTRUCTION PROGRESS SCHEDULE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 REFERENCE STANDARDS**

- A. AGC (CPSM) - Construction Planning and Scheduling Manual 2004.
- B. M-H (CPM) - CPM in Construction Management - Project Management with CPM 2015.

**1.03 SUBMITTALS**

- A. Within 10 days after date of Agreement, submit preliminary schedule.
- 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.
- F. Submit the number of opaque reproductions that Contractor requires, plus two copies that will be retained by Architect.

**1.04 QUALITY ASSURANCE**

- A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with one 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. Diagram Sheet Size: Maximum 22 x 17 inches.
- C. Sheet Size: Multiples of 8-1/2 x 11 inches.
- D. Scale and Spacing: To allow for notations and revisions.

**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. Identify work of separate stages and other logically grouped activities.
- D. Provide sub-schedules for each stage of Work identified in Section 011000 - Summary.
- E. Provide sub-schedules to define critical portions of the entire schedule.
- F. Include conferences and meetings in schedule.

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- G. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- H. 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.
- I. Indicate delivery dates for owner-furnished products.
- J. Coordinate content with schedule of values specified in Section 012000 - Price and Payment Procedures.
- K. 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.
- 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.
- G. Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect.

### **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**

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**SECTION 014000  
QUALITY REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Submittals.
- B. Quality assurance.
- C. References and standards.
- D. Testing and inspection agencies and services.
- E. Contractor's construction-related professional design services.
- F. Contractor's design-related professional design services.
- G. Control of installation.
- H. Mock-ups.
- I. Tolerances.
- J. Manufacturers' field services.
- K. Defect Assessment.
- L. DSA approved testing and inspection services.

**1.02 REFERENCE STANDARDS**

- A. IAS AC89 - Accreditation Criteria for Testing Laboratories 2021.
- B. Title 24 CCR, Part 1: Continuous inspection, Section 4-333
- C. CBC Chapter 17A - California Building Code Structural Testing and Inspection

**1.03 DEFINITIONS**

- A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.
- B. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
  - 1. Design Services Types Required:
    - a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor's sole responsibilities for construction means, methods, techniques, sequences, and procedures.
    - b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.
- C. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

**1.04 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES**

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
  - 1. Temporary sheeting, shoring, or supports.
  - 2. Temporary scaffolding.
  - 3. Temporary bracing.

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### 1.05 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Base design on performance and/or design criteria indicated in individual specification sections.
- C. Scope of Contractor's Professional Design Services: Provide for the following items of work:
  - 1. DSA required deferred approval submittals..

### 1.06 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Designer's Qualification Statement: Submit for Architect's knowledge as contract administrator, or for Owner's information.
  - 1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
    - a. Full name.
    - b. Professional licensure information.
    - c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.
- C. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
  - 1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
  - 2. Include required product data and shop drawings.
  - 3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
  - 4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.
- D. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
  - 1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of inspector.
    - d. Date and time of sampling or inspection.
    - e. Identification of product and specifications section.
    - f. Location in the Project.
    - g. Type of test/inspection.
    - h. Date of test/inspection.
    - i. Results of test/inspection.
    - j. Compliance with Contract Documents.
    - k. When requested by Architect, provide interpretation of results.
    - l. CBC Chapter 17A required special tests and inspections per DSA-approved Form 103, 'Statement of Structural Tests and Special Inspections"
  - 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
  - 3. 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.
- E. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.

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1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
  2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- F. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- G. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
1. Submit report in duplicate within 30 days of observation to Architect for information.
  2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.
- H. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.
  2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.
- I. Contractor's Statement of Responsibility: Submit copy of written statement of responsibility sent to DSA before starting work on the following systems, per CBC Section 17A:
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.

## 1.07 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
  2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
  3. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.
- B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- C. Contractor's Quality Control (CQC) Plan:
1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
    - a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority.
      - 1) Include qualifications (in resume form), duties, responsibilities of each person assigned to CQC function.
    - b. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
      - 1) Management and control of documents and records relating to quality.
      - 2) Communications.

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- 3) Coordination procedures.
- 4) Resource management.
- 5) Process control.
- 6) Inspection and testing procedures and scheduling.
- 7) Control of noncomplying work.
- 8) Tracking deficiencies from identification, through acceptable corrective action, and verification.
- 9) Control of testing and measuring equipment.
- 10) Project materials certification.
- 11) Managerial continuity and flexibility.
- c. Owner will not make a separate payment for providing and maintaining a Quality Control Plan. Include associated costs in Bid price.
- d. Acceptance of the plan is required prior to start of construction activities not including mobilization work. Owner's acceptance of the plan will be conditional and predicated on continuing satisfactory adherence to the plan. Owner reserves the right to require Contractor to make changes to the plan and operations, including removal of personnel, as necessary, to obtain specified quality of work results.
- D. Quality-Control Personnel Qualifications. Engage a person with requisite training and experience to implement and manage quality assurance (QA) and quality control (QC) for the project.

#### 1.08 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 of Contract Documents, 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. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- F. 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.

#### 1.09 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Owner will employ services of an independent testing agency to perform certain specified testing; payment for cost of services will be derived from allowance specified in Section 012100; see Section 012100 and applicable sections for description of services included in allowance.
- B. Owner will employ and pay for services of an independent testing agency to perform other specified testing.
- C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- D. Project Inspector: A Class I Project Inspector employed by the District and approved by DSA, providing continuous inspection 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.
- E. Tests

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1. The owner will select an independent testing laboratory to conduct the tests. Selection of the material required to be tested shall be by the laboratory or the Owner's representative and not by the Contractor.
2. The Contractor shall notify the Owner's representative a sufficient time in advance of the manufacture of material to be supplied by him under the Contract Documents, which must by terms of the contract be tested, in order that the owner may arrange for the testing of same at the source of supply.
3. Any material shipped by the Contractor from the source of supply prior to having satisfactorily passed such testing and inspection or prior to the receipt of notice from said representative that such testing and inspection will not be required shall not be incorporated in the Job.
4. The Owner will select and pay testing laboratory costs for all tests and inspections, but may be reimbursed by the Contractor for such costs under the Contract documents.

F. Test Reports

1. One copy of all test reports shall be forwarded to the Division of the State Architect by the testing agency. Such reports shall include all tests made, regardless of whether such tests indicate that the material is satisfactory or unsatisfactory. Samples taken but not tested shall also be reported. Records of special sampling operations as required shall also be reported. The reports shall show that the material or materials were sampled and tested in accordance with the requirements of Title 24 and with the approved specifications. Test reports shall show the specified design strength. They shall also state definitely whether or not the material or materials tested comply with requirements.

G. Verification of Test Reports

1. Each testing agency shall submit to the Division of the State Architect a verified report in duplicate covering all the tests which are required to be made by that agency during the progress of the project. Such report shall be furnished each time that work on the project is suspended, covering the test up to that time, and at the completion of the project, covering all tests.

H. Inspection by the owner

1. The owner and their representatives shall at all times have access for the purpose of inspection to all parts of the work and to the shops wherein the work is in preparation, and the Contractor shall at all times maintain proper facilities and provide safe access for such inspection.
2. The Owner shall have the right to reject materials and workmanship, which are defective, or to require their correction. Rejected workmanship shall be satisfactorily corrected and rejected materials shall be removed from the premises without charge to the Owner. If the Contractor does not correct such rejected work within a reasonable time, fixed by written notice, the Owner may correct same and charge the expense to the Contractor.
3. Should it be considered necessary or advisable by the Owner at any time before final acceptance of the entire work to make an examination of the work already completed by removing or tearing out the same, the Contractor shall on request promptly furnish all necessary facilities, labor and materials. If such work is found to be defective in any respect due to the fault of the Contractor or his subcontractor, he shall defray all expenses of such examinations and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the Contract, the additional cost of labor and material necessarily involved in the examination and replacement shall be allowed the Contractor.

I. Inspector- Owner's

1. A DSA certified Project Inspector and special inspector shall be employed by the Owner in accordance with the requirements of the California Code of regulations, Title 24, Part 1, will be assigned to the work. Their duties are specifically defined in Section 4-342 of Title 24, Part 1.
2. The work of construction in all stages of progress shall be subjected to the personal continuous observation of the Inspector. He shall have free access to any or all parts of the work at any time. The Contractor shall furnish the Inspector reasonable facilities for

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obtaining such information as may be necessary to keep him fully informed respecting the progress and manner of the work and the character of the materials. Inspection of the work shall not relieve the Contractor from any obligation to fulfill this Contract.

- J. Inspector- Owner- Field Office
  - 1. The Contractor shall provide for the use of the Owner's Inspector a temporary office to be located as directed by the Inspector and to be maintained until removal is authorized by the Owner. This office shall be of substantial waterproof construction with adequate natural light and ventilation by means of stock design windows. The door shall have a lock. A table satisfactory for the study of plans and two chairs shall be provided by the Contractor. The Contractor shall provide and pay for adequate electric lights, private local telephone service with a loud exterior bell, and adequate heat for this field office until the completion of the Contract.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 CONTROL OF INSTALLATION**

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

**3.02 TOLERANCES**

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

**3.03 TESTING AND INSPECTION**

- A. Testing Agency Duties:
  - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
  - 2. Perform specified sampling and testing of products in accordance with specified standards.
  - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
  - 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
  - 5. Perform additional tests and inspections required by Architect.
  - 6. Attend preconstruction meetings and progress meetings.
  - 7. Submit reports of all tests/inspections specified.
- B. Limits on Testing/Inspection Agency Authority:
  - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.



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2. Agency may not approve or accept any portion of the Work.
  3. Agency may not assume any duties of Contractor.
  4. Agency has no authority to stop the Work.
- C. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
  2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
  3. Provide incidental labor and facilities:
    - a. To provide access to Work to be tested/inspected.
    - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
    - c. To facilitate tests/inspections.
    - d. To provide storage and curing of test samples.
  4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
  5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
  6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

#### **3.04 MANUFACTURERS' FIELD SERVICES**

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

#### **3.05 DEFECT ASSESSMENT**

- A. Replace Work or portions of the Work not complying with specified requirements.
- B. If, in the opinion of construction manager, it is not practical to remove and replace the work, construction manager will direct an appropriate remedy or adjust payment.
- C. The owner will select an independent testing laboratory to conduct the tests. Selection of the material required to be tested shall be by the laboratory or the Owner's representative and not by the Contractor.

**END OF SECTION**

**TITLE 24, PART 2 (2016 CBC) - VOLUME 2**

<b>TESTS AND INSPECTION REQUIREMENTS</b>	<b>CBC SECTION</b>
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• STRENGTH TESTS OF CONCRETE	1905A.1.16; Table 1705A.3 Item 6; ACI 318-14 Sec. 26.12
• SHOTCRETE PROPORTIONS	1908A.2
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•	
•	
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**SECTION 015000  
TEMPORARY FACILITIES AND CONTROLS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 REFERENCE STANDARDS**

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).

**1.03 TEMPORARY UTILITIES**

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

**1.04 TELECOMMUNICATIONS SERVICES**

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:
  - 1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
  - 2. Telephone Land Lines: One line, minimum; one handset per line.
  - 3. Internet Connections: Minimum of one; DSL modem or faster.
  - 4. Email: Account/address reserved for project use.

**1.05 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.

**1.06 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.

**1.07 FENCING**

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

**1.08 INTERIOR ENCLOSURES**

- A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
- B. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:

**1.09 SECURITY**

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

**1.10 VEHICULAR ACCESS AND PARKING**

- 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.
- E. Do not allow vehicle parking on existing pavement.

**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, construction, and location approved by Owner.
- B. 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. Clean and repair damage caused by installation or use of temporary work.
- C. Restore existing facilities used during construction to original condition.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

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**END OF SECTION**

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**SECTION 015639  
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(which would include the entire existing canopy) groups of trees, shrubs, or other vegetation to be protected during construction. Refer to drawings to review the protected trees and vegetation.
- 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) volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
- C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction. **NO PRUNING SHALL BE DONE WITHOUT ARBORIST APPROVAL.**
  - 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.

**1.05 QUALITY ASSURANCE**

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- 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.
  - 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.

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- a. Height: 6 feet (1.8 m).
- b. Galvanized
- 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. Review plans to ensure
- B. 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.
- C. 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.
- D. Maintain protection zones free of weeds and trash.
- E. 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.



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- F. 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

- 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.

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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"
- 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**

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**SECTION 015713  
TEMPORARY EROSION AND SEDIMENT CONTROL**

**<<<< UPDATE NOTES: SEE MASTER NOTES FOR ADDITIONAL INFORMATION.>>>>**

**PART 1 GENERAL**

**3.01 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.

**3.02 RELATED REQUIREMENTS**

- A. Section 033000 - Cast-in-Place Concrete: Concrete for temporary and permanent erosion control structures indicated on drawings.
- B. Section 311000 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.
- C. Section 312200 - Grading: Temporary and permanent grade changes for erosion control.
- D. Section 321123 - Aggregate Base Courses: Temporary and permanent roadways.

**3.03 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 2021.
- B. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity. 1999a (Reapproved 2014).
- C. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles 2015.
- D. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles 2015a.
- E. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile 2021a.
- F. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples 2017 (Reapproved 2021).
- G. California State Water Resources Control Board, Construction General Permit; current edition.
- H. California Stormwater Quality Association (CASQA), California Stormwater Best Management Practice (BMP) Handbook; current edition.
- I. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit Current Edition.
- J. USDA TR-55 - Urban Hydrology for Small Watersheds; USDA Natural Resources Conservation Service 2015.

**3.04 PERFORMANCE REQUIREMENTS**

- A. Comply with all requirements of [ ] for erosion and sedimentation control .
- B. Best Management Practices Standard: CASQA Stormwater BMP Handbook.
- C. 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.

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2. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.
- D. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- E. 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.
- F. 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.
- G. 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.
- H. 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.
- I. 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.
- J. Open Water: Prevent standing water that could become stagnant.
- K. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

### 3.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Erosion and Sedimentation Control Plan:
  1. Submit within 2 weeks after Notice to Proceed.
  2. Include:
    - a. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
    - b. Schedule of temporary preventive measures, in relation to ground disturbing activities.
    - c. Other information required by law.
    - d. Format required by law is acceptable, provided any additional information specified is also included.

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3. Obtain the approval of the Plan by Owner.
- C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.
- D. Maintenance Instructions: Provide instructions covering inspection and maintenance for temporary measures that must remain after Substantial Completion.

## **PART 2 PRODUCTS**

### **4.01 MATERIALS**

- A. Mulch: Use one of the following:
  1. Straw or hay.
  2. Erosion control matting or netting.
  3. Polyethylene film, where specifically indicated only.
- 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.
- C. Bales: Air dry, rectangular straw bales.
- D. Bale Stakes: One of the following, minimum 3 feet long:
  1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
  2. Wood, 2 by 2 inches in cross section.
- E. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
  1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
  2. Permittivity: 0.05 sec<sup>-1</sup>, minimum, when tested in accordance with ASTM D4491.
  3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
  4. Tensile Strength: 100 pounds-force, minimum, in cross-machine direction; 124 pounds-force, minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
  5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
  6. Tear Strength: 55 pounds-force, minimum, when tested in accordance with ASTM D4533/D4533M.
  7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
- F. Silt Fence Posts: One of the following, minimum 5 feet long:
  1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
- G. Gravel: See Section 321123 for aggregate.
- H. Concrete: See Section 033000.

## **PART 3 EXECUTION**

### **5.01 EXAMINATION**

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

### **5.02 PREPARATION**

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

### **5.03 MAINTENANCE**

- A. Inspect preventive measures as required by the Storm Water Pollution Prevention Plan (SWPPP).
- B. Repair deficiencies immediately.

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- C. Clean out temporary sediment control structures [ ] and relocate soil on site.
- D. Place sediment in appropriate locations on site; do not remove from site.

**5.04 CLEAN UP**

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

**END OF SECTION**

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**SECTION 016000  
PRODUCT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. General product requirements.
- B. Re-use of existing products.
- C. Transportation, handling, storage and protection.
- D. Product option requirements.
- E. Substitution limitations.
- F. Procedures for Owner-supplied products.
- G. Maintenance materials, including extra materials, spare parts, tools, and software.

**1.02 REFERENCE STANDARDS**

- A. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers 2017, v1.2.

**1.03 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.

**1.04 QUALITY ASSURANCE**

- A. CAL (CDPH SM) v1.1: California Department of Public Health (CDPH) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, v. 1.1–2010, for the emissions testing and requirements of products and materials.

**PART 2 PRODUCTS**

**2.01 EXISTING PRODUCTS**

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
- B. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.
- C. Specific Products to be Reused: The reuse of certain materials and equipment already existing on the project site is required.
  - 1. See Section 011000 for list of items required to be salvaged for reuse and relocation.

**2.02 NEW PRODUCTS**

- A. Provide new products unless specifically required or permitted by the Contract Documents.
- B. Use of products having any of the following characteristics is not permitted:
  - 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 asebestos or lead-based paint.

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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.

### **2.03 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.

### **2.04 MAINTENANCE MATERIALS**

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

## **PART 3 EXECUTION**

### **3.01 SUBSTITUTION LIMITATIONS**

- A. See Section 012500 - Substitution Procedures.
- B. A request for substitution constitutes a representation that the submitter:
  - 1. Will obtain necessary approval of agencies having jurisdiction.
- C. Construction Document Revisions
  - 1. Should a Contractor-proposed substitution or alternative sequence or method of
  - 2. construction require revision of the Contract Drawings or Specifications, including revisions
  - 3. for the purposes of determining feasibility, scope or cost, or revisions for the purpose of
  - 4. obtaining review and approval by authorities having jurisdiction, revisions will be made by
  - 5. Architect or other consultant of the District who is the responsible design professional, as
  - 6. approved in advance by District's Representative.
  - 7. Services of Architect, other responsible design professionals and District for researching
  - 8. and reporting on proposed substitutions or alternative sequence and method of
  - 9. construction shall be paid by Contractor when such activities are considered additional
  - 10. services to the design services contracts of Architect or other responsible design
  - 11. professional with District.
  - 12. Costs of services by Architect, other responsible design professionals and District shall be
  - 13. paid, including travel, reproduction, long distance telephone and shipping costs
  - 14. reimbursable at cost plus usual and customary mark-up for handling and billing.
  - 15. Such fees shall be paid whether or not the proposed substitution or alternative sequence
  - 16. or method of construction is ultimately accepted by District and a Change Order is
  - 17. executed.
  - 18. Such fees shall be paid from Contractor's portion of savings, if a net reduction in Contract
  - 19. Sum results. If fees exceed Contractor's portion of net reduction, Contractor shall pay all
  - 20. remaining fees unless otherwise agreed in advance by District's Representative.

### **3.02 OWNER-SUPPLIED PRODUCTS**

- A. Owner's Responsibilities:



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1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
  2. Arrange and pay for product delivery to site.
  3. On delivery, inspect products jointly with Contractor.
  4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
  5. Arrange for manufacturers' warranties, inspections, and service.
- B. Contractor's Responsibilities:
1. Review Owner reviewed shop drawings, product data, and samples.
  2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
  3. Handle, store, install and finish products.
  4. Repair or replace items damaged after receipt.

### **3.03 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.

### **3.04 STORAGE AND PROTECTION**

- 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 weathertight, 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.

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- 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**

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**SECTION 017000  
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, except removal, disposal, and/or remediation of hazardous materials and toxic substances.
- C. Cutting and patching.
- D. Surveying for laying out the work.
- E. Cleaning and protection.
- F. Starting of systems and equipment.
- G. Demonstration and instruction of Owner personnel.
- H. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- I. General requirements for maintenance service.

**1.02 RELATED REQUIREMENTS**

- A. Section 015000 - Temporary Facilities and Controls: Temporary exterior enclosures.
- B. Section 015000 - Temporary Facilities and Controls: Temporary interior partitions.
- C. Section 017800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.
- D. Section 017900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections

**1.03 REFERENCE STANDARDS**

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations 2022, with Errata (2021).

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
  - 1. On request, submit documentation verifying accuracy of survey work.
  - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
  - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
  - 1. Structural integrity of any element of Project.
  - 2. Integrity of weather exposed or moisture resistant element.
  - 3. Efficiency, maintenance, or safety of any operational element.
  - 4. Visual qualities of sight exposed elements.
  - 5. Work of Owner or separate Contractor.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities.

**1.05 QUALIFICATIONS**

- A. For demolition work, employ a firm specializing in the type of work required.
- B. 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

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and experienced in collecting and recording accurate data relevant to ongoing construction activities,

### 1.06 PROJECT CONDITIONS

- A. Use of explosives is not permitted.
- 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.
  - 1. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.
- 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.
- G. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
- H. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- I. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

### 1.07 COORDINATION

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

## 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.

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- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - 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 LAYING OUT THE WORK**

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. 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; and [\_\_\_\_\_].
  2. Grid or axis for structures.
  3. Building foundation, column locations, ground floor elevations, and [\_\_\_\_\_].
- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.

#### **3.04 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.

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- 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.

### 3.05 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. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
  - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000 in locations indicated on drawings.
- C. Remove existing work as indicated and as required to accomplish new work.
  - 1. Remove items indicated on drawings.
  - 2. Relocate items indicated on drawings.
  - 3. 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.
  - 4. 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, and Telecommunications): 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.

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- 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.
  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.

### 3.06 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 078400, 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.

### 3.07 PROGRESS CLEANING

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- 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.

### **3.08 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. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.
- G. 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.
- H. Prohibit traffic from landscaped areas.
- I. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

### **3.09 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. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

### **3.10 DEMONSTRATION AND INSTRUCTION**

- A. See Section 017900 - Demonstration and Training.

### **3.11 ADJUSTING**

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.
- B. Testing, adjusting, and balancing HVAC systems: See Section 230593 - Testing, Adjusting, and Balancing for HVAC.

### **3.12 FINAL CLEANING**

- A. Execute final cleaning prior to final project assessment.



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1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.
- 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.
- 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.

### 3.13 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
  1. Provide copies to Owner.
- 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. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
    - b. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
    - 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. 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.

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- 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.

### **3.14 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.
- C. Before requesting final inspection for determining final completion, complete the following:
  - 1. Submit copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), certified by the Contractor, stating that each item has been completed or otherwise resolved for acceptance. This inspection list will be reviewed and dated by Architect.
  - 2. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- D. 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.

### **3.15 MAINTENANCE**

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

**END OF SECTION**

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**SECTION 017419  
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 develop and follow a Waste Management Plan designed to implement these requirements.
- E. The following sources may be useful in developing the Waste Management Plan:
  - 1. Sample forms found in "A Guide to the California Green Building Standards Code (Nonresidential)" located at <https://www.dgs.ca.gov/BSC/Resources/Page-Content/Building-Standards-CommissionResource-List-Folder/CALGreen> may be used to assist in documenting compliance with the waste management plan.
  - 2. Mixed construction and demolition debris (C&D) processors can be located at the California Department of Resources Recycling and Recovery (CalRecycle)
- F. 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.
- G. 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 RELATED REQUIREMENTS**

- A. Section 013000 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. Section 015000 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.
- C. Section 016000 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.
- D. Section 017000 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

**1.03 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.

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- F. **Recyclable:** The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. **Recycle:** To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. **Recycling:** The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. **Return:** To give back reusable items or unused products to vendors for credit.
- J. **Reuse:** To reuse a construction waste material in some manner on the project site.
- K. **Salvage:** To remove a waste material from the project site to another site for resale or reuse by others.
- L. **Sediment:** Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. **Source Separation:** The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. **Toxic:** Poisonous to humans either immediately or after a long period of exposure.
- O. **Trash:** Any product or material unable to be reused, returned, recycled, or salvaged.
- P. **Waste:** Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

#### 1.04 SUBMITTALS

- A. **Submit Waste Management Plan** within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner; submit projection of all trash and waste that will require disposal and alternatives to landfilling.
- B. **Waste Management Plan:** Include the following information:
  - 1. **Analysis of the trash and waste** projected to be generated during the entire project construction cycle, including types and quantities.
  - 2. **Landfill Options:** The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
  - 3. **Landfill Alternatives:** List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
    - a. List each material proposed to be salvaged, reused, or recycled.
    - b. List the local market for each material.
    - c. State the estimated net cost, versus landfill disposal.
  - 4. **Meetings:** Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
  - 5. **Materials Handling Procedures:** Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
  - 6. **Transportation:** Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.
- C. **Waste Disposal Reports:** Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
  - 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
  - 2. Submit Report on a form acceptable to Owner.
  - 3. **Landfill Disposal:** Include the following information:
    - a. Identification of material.

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- b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
  - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
  - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
4. Incinerator Disposal: Include the following information:
    - a. Identification of material.
    - b. Amount, in tons or cubic yards, of trash/waste material from the project delivered to incinerators.
    - c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
    - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
  5. Recycled and Salvaged Materials: Include the following information for each:
    - a. Identification of material, including those retrieved by installer for use on other projects.
    - b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
    - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
    - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
    - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
  6. Material Reused on Project: Include the following information for each:
    - a. Identification of material and how it was used in the project.
    - b. Amount, in tons or cubic yards.
    - c. Include weight tickets as evidence of quantity.
  7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

### **PART 3 EXECUTION**

#### **2.01 WASTE MANAGEMENT PROCEDURES**

- A. See Section 013000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. See Section 015000 for additional requirements related to trash/waste collection and removal facilities and services.
- C. See Section 016000 for waste prevention requirements related to delivery, storage, and handling.
- D. See Section 017000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

#### **2.02 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. Meetings: Discuss trash/waste management goals and issues at project meetings.
  1. Prebid meeting.

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2. Preconstruction meeting.
  3. Regular job-site meetings.
- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
1. Provide containers as required.
  2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
  3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

**END OF SECTION**

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**SECTION 017800  
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 013000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Section 017000 - Execution and Closeout Requirements: Contract closeout procedures.
- C. Individual Product Sections: Specific requirements for operation and maintenance data.
- D. 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. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
  - 2. Submit one 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.
  - 3. 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.
  - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

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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 and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  3. Field changes of dimension and detail.
  4. 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:
  1. Product data, with catalog number, size, composition, and color and texture designations.
  2. Information for re-ordering custom manufactured products.
- 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. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Include color coded wiring diagrams as installed.
- E. 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.
- F. Include test and balancing reports.

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



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- 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.
- J. Arrangement of Contents: Organize each volume in parts as follows:
  - 1. Project Directory.
  - 2. Table of Contents, of all volumes, and of this volume.
  - 3. Operation and Maintenance Data: Arranged by system, then by product category.
    - a. Source data.
    - b. Operation and maintenance data.
    - c. Field quality control data.
    - d. Photocopies of warranties and bonds.

### **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.
- E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.

**END OF SECTION**

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**SECTION 017900  
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. Electrical systems and equipment.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
  - 1. Finishes, including flooring, wall finishes, ceiling finishes.

**1.02 SUBMITTALS**

- A. See Section 013000 - 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 a 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.
- D. Training Reports:
  - 1. Identification of each training session, date, time, and duration.
  - 2. Sign-in sheet showing names and job titles of attendees.
  - 3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
  - 4. Include Commissioning Authority's formal acceptance of training session.

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### 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.

### 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.

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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.
  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**

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**SECTION 024100  
DEMOLITION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 REFERENCE STANDARDS**

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

**1.03 SUBMITTALS**

- A. See Section 013000 - 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.

**1.04 QUALITY ASSURANCE**

- A. Demolition Firm Qualifications: Company specializing in the type of work required.

**PART 2 PRODUCTS**

**PART 3 EXECUTION**

**3.01 SCOPE**

- A. Remove other items indicated, for salvage, relocation, and recycling.

**3.02 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. 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.
  - 3. Provide, erect, and maintain temporary barriers and security devices.
  - 4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
  - 5. Do not close or obstruct roadways or sidewalks without permit.
  - 6. 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.
  - 7. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. 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.
- 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.

**3.03 EXISTING UTILITIES**

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

### **3.04 SELECTIVE DEMOLITION FOR ALTERATIONS**

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
  - 1. Verify that construction and utility arrangements are as 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, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- D. Protect existing work to remain.
  - 1. Prevent movement of structure; provide shoring and bracing if necessary.
  - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  - 3. Repair adjacent construction and finishes damaged during removal work.
  - 4. Patch as specified for patching new work.

### **3.05 DEBRIS AND WASTE REMOVAL**

- 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**

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**SECTION 031000  
CONCRETE FORMWORK**

**PART 1 - GENERAL**

**1.01 SUMMARY:**

- A. Section Includes:
  - 1. Design and construction of formwork for concrete.
  - 2. Setting in forms, all anchor bolts, metal inserts, sleeves, etc., embedded in concrete.
  - 3. Miscellaneous concrete work, including but not limited to areaways, cast-in-place valve boxes, pits, splash blocks, equipment bases, and other items as shown or required to complete all Work.
- B. Related Work Specified Elsewhere:
  - 1. Concrete Paving: Formwork for site concrete work, Section 32 13 13.
  - 2. Furnishing and placing reinforcing for cast-in-place concrete, Section 03 20 00.
  - 3. Furnishing, placing, finishing, and curing of cast-in-place concrete, Section 03 30 00.
  - 4. Placing of embedded anchor bolts and inserts, Section 03 30 00.
  - 5. Screeds for slabs, Section 03 30 00.

**1.02 REFERENCES, CODES AND STANDARDS:** The following latest edition of the references, codes and standards are hereby made a part of this Section and work shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings. Latest adopted edition of references and codes adopted by the Governing Agency shall apply. Nothing contained herein shall be construed as permitting work that is contrary to code requirements.

- A. American Concrete Institute (ACI) – ACI 347 "Recommended Practice for Concrete Formwork".
- B. American Concrete Institute (ACI) – ACI 301 "Specifications for Structural Concrete Buildings."
- C. Standard Tolerances for Concrete Construction and Materials - ACI 117.
- D. Building Code Requirements for Reinforced Concrete - ACI 318.
- E. International Building Code with State of California Amendments (CBC).
- F. West Coast Lumber Inspection Bureau (WCLIB) Grading and Dressing Rules No. 17.

**1.03 DEFINITIONS:**

- A. Unexposed Finish: A general-use finish, with no appearance criteria, applicable to all formed concrete concealed from view after completion of construction.
- B. Exposed Finish: A general-use finish applicable to all formed concrete exposed to view and including surfaces which may receive a paint coating (if any).

**1.04 SYSTEM REQUIREMENTS:**

- A. Formwork Design Requirements: Formwork products and execution specified herein are for finish surface quality only.
  - 1. Design, layout and construction of formwork shall be solely the responsibility of the Contractor.
  - 2. Design and construct formwork, shoring and bracing to conform to CBC requirements and ACI 318.
  - 3. Resulting concrete shall conform to shapes, lines and dimensions indicated and required.
  - 4. Tolerances for concrete shall be as specified in ACI 117, ACI 301, ACI 318 and ACI 347, unless otherwise specified or indicated.

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**1.05 SUBMITTALS:**

- A. Timing: Allow a minimum of two weeks for review of submittals.
- B. Shop Drawings: Submit shop drawings showing form pattern layouts of all exposed exterior and interior concrete dimensioned to precisely locate grooves, form panel jointing, and similar features. Review and approval will not include form strength and adequacy.
- C. Record Document: Keep an accurate record of the dates of removal of forms, form shores and reshores, and furnish copies to the Architect.
- D. Submit product data for all proprietary items to be used on project.

**1.06 QUALITY ASSURANCE:**

- A. Construct forms according to ACI 347 "Recommended Practice for Concrete Formwork", and conforming to tolerances specified in ACI 301, "Specifications for Structural Concrete for Buildings", as applicable, unless exceeded by code requirements or otherwise indicated or specified.
- C. Formwork Designer's Qualifications: When required by authorities having jurisdiction, designer of formwork shall be a Civil or Structural Engineer registered to practice in the State of California.

**1.07 REGULATORY REQUIREMENTS:**

- A. Regulatory Requirements: Conform to formwork construction requirements of the California Building Code (CBC) as amended and adopted by authorities having jurisdiction.
- B. Coordination: Coordinate Work specified in this Section with other Sections which require placement of embedded products and provision of openings and recesses. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from the Architect before proceeding.

**1.08 DELIVERY, STORAGE, AND HANDLING:**

- A. Deliver materials for forms in timely manner to ensure uninterrupted progress.
- B. Store materials by methods that prevent damage and permit ready access for inspection and identification.

**PART 2 - PRODUCTS**

**2.01 MATERIALS:**

- A. Form lumber: WCLIB "Construction" grade or better, WWPA No. 1 or better, or equal.
- B. Form plywood: PS-1, Group I, Exterior Grade B-B Plyform or better, minimum 5-ply and 3/4" thick for exposed locations and not less than 5/8" thick for unexposed locations, grade marked, not mill oiled, Plywood having medium or high density overlay is acceptable.
- C. Coated form plywood: For exposed painted concrete, plastic overlaid plywood of grade specified above, factory coated with a form coating and release agent equal to "Noxcrete".
- D. Tube forms: Burke "SmoothTube", Sonoco "Seamless Sonotubes", Alton Building Products "Sleek Seamless Standard Wall", or equal, type leaving no marks in concrete, 1-piece lengths for full required heights.
- G. Hardboard: For curved surfaces, tempered hardboard, Masonite Corp., or equal.
- H. Lumber: Douglas fir or Douglas fir-larch, grade appropriate for intended use, sound and undamaged straight edges, solid knots.
- I. Fillets for Chamfered Corners: Wood molding at plywood or lumber forms; rigid plastic at steel, fiberglass and plastic forms.
- J. Embedded Nailers: Clear all heart redwood or pressure preservative-treated (PPT) Douglas fir, edges reverse beveled to key into concrete.



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- K. Form ties: Prefabricated rod, flat band, wire, internally threaded disconnecting type, or equal, not leaving metal within 1-1/2" of concrete surface leaving no hole larger than 1".
- L. Form coating: Non-staining clear coating free from oil, silicone, wax, not grain-raising, "Formshield" by A.C. Horn, Inc., "Release" by Burke Concrete Accessories, or "Cast-Off" by Sonneborn Building Products. Where form liners are used, provide form coatings recommended by form liner manufacturer. Form coating shall comply with applicable air quality regulations for volatile organic compounds (VOC's).
- M. Form liner: Rigid or resilient type by L.M. Scofield, Labrado Forms, Symons, Greenstreak, or equal, types shown or directed, matching approved Sample.

### **PART 3 - EXECUTION**

#### **3.01 WORKMANSHIP:**

- A. Rigidly construct forms to prevent mortar leakage, sagging, displacement or bulging between studs. Use clean, sound, approved form material and coated with specified materials only, not oil. Provide backing on all plywood joints.
- B. Sides of all footings and grade beams shall be formed, unless permission is obtained to place concrete directly against earth. Where this permission is granted, the footing or grade beam dimension shall be increased 3". Remove formwork prior to backfilling operations.

#### **3.02 FORM ERECTION AND REMOVAL:**

- A. Conform to ACI 301 and ACI 347 except as exceeded by the requirements of Code, regulatory agencies, or herein.
- B. Formwork Bracing and Shoring: Provide bracing and shores to ensure stability of formwork and accommodate all construction loads. Use form ties of sufficient strength and sufficient quantities to prevent formwork spreading. Maintain principal shores to support concrete until minimum required strength is achieved.
- C. Construction: Coat forms with the specified resin coating, not form oil. Construct forms to exact shapes, sizes, lines, and dimensions required to obtain level, plumb, and straight surfaces. Provide openings, offsets, keys, reglets, anchorages, recesses, moldings, chamfers, blocking, screeds, drips, bulkheads, and all other required features. Make forms easily removable without hammering or prying against concrete. Space forms apart with metal spreaders. Construct forms to accurate alignment, location and grades, and provide against sagging, leakage of concrete mortar, or displacement occurring during and after placing of concrete. Coordinate installation of inserts and anchors in forms according to Shop Drawings and requirements for work of other sections.
- D. Corners and Angles: Provide 3/4" by 3/4" beveled chamfer strips for all exposed concrete corners and angles unless otherwise indicated. Form concealed concrete corners and angles square unless otherwise indicated.
- E. Reglets and Rebates: Form required reglets and rebates to receive frames, flashing, and other equipment. Obtain required dimensions, details, and precise positions for work to be installed under other sections and form concrete accordingly.
- F. Form Joints: Fill joints to produce smooth surfaces, intersections, and arrises. Use polymer foam or equivalent fillers at joints and where forms abut or overlap existing concrete to prevent leakage of mortar.
- G. Recesses, Drips, and Profiles: Provide smooth milled wood or preformed rubber or plastic shapes of types shown and required.
- H. Cleanouts and Cleaning: Provide temporary openings in all wall forms and other vertical forms for cleaning and inspection. Clean forms and surfaces to receive concrete prior to placing.

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- I. Screeds: Set screeds and establish level for tops of concrete slabs and leveling for finish surfaces. Shape surfaces as indicated on the Drawings. Provide cradle, pad or base type screed supports for concrete over waterproof membranes and vapor retarders.
- J. Form Cleaning, General: Clean and remove foreign matter within forms as erection and placement proceeds. Clean formed cavities of debris prior to concrete placement.
- K. Formwork Reuse: Do not reuse wood and plywood forming materials which contact concrete, except as follows:
  - 1. High density plywood may be cleaned and reused for exposed concrete.
  - 2. Unfaced plywood may be reused for concealed concrete.
  - 3. Steel and fiberglass forming materials may be cleaned and reused.
- L. Patching and Repairs: Patch tie holes with sheet metal patches and restore forms to like new condition prior to reuse. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable.
- M. Form Removal: Do not remove concrete forms until concrete attains sufficient strength to support its own weight and all superimposed loads as determine by testing field cured concrete cylinders, but not sooner than specified in ACI 347. Load supporting forms may be removed when concrete has attained 75 percent of required 28 day compressive strength but no sooner than 3 days, provided construction is reshored. Vertical formwork for cast-in-place concrete walls may be removed no sooner than 1 day following concrete placement, provided that contractor can demonstrate that no sloughing or sagging of concrete will occur.
  - 1. Reshore structural members as specified below because of design requirements or construction conditions to permit successive construction.
  - 2. Remove formwork progressively so unbalanced loads are not imposed on the structure.
  - 3. Avoid damage concrete surfaces during form removal.
  - 4. Remove or snap off metal spreader ties inside wall surface. Cut nails and form ties off flush and leave surfaces level and clean.
  - 5. Store reusable forms for exposed architectural concrete to prevent damage to contact surfaces.
  - 6. Remove formwork in same sequence as concrete placement to achieve similar concrete surface coloration.
- N. Reshoring:
  - 1. Minimum reshoring shall be as per the requirements of ACI 347. Reshoring of not less than half the full required shoring shall be added under last placed floor over which full shoring is to be placed for the next floor above. Leave reshoring in place for at least 7 days after the floor above is placed, but in no case remove reshoring until next concrete placing has attained a compressive strength equal to 66% of that required for the 28 day age as determined by control test cylinders specified hereinafter.
  - 2. Record: Maintain a form and shoring removal record.
  - 3. Contractor shall submit shoring/reshoring plans and calculations for review and approval. Calculations and plans shall be stamped and signed by a licensed civil or structural engineer in the State of California. Reshoring loads to the lower floors shall be consistent with the design loads specified in the construction documents and with the acquired strength of the lower floors based on the time they have been allowed to cure before being loaded.
- O. Shoring for Tributary Loads: Set temporary shoring for structural steel beams supporting cast-in-place concrete slabs. Such shoring is not required where beams are partially or totally encased with concrete nor for steel beams supporting concrete or masonry walls resting on the beams.

### 3.03 FORMWORK TOLERANCES:

Concrete Formwork	031000 - 4
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- A. Deflection: Limit deflection of forming surfaces from concrete pressure to L/240.
- B. Finish Lines: Position formwork to maintain hardened concrete finish lines within following permissible deviations.
  - 1. Variation from Plumb:
 

In 10'-0"	1/4 inch
In any story or 20'-0"	3/8 inch
In 40'-0" or more	3/4 inch
  - 2. Variation from Level or Grades Indicated
 

In 10'-0"	1/4 inch
In any bay or 20'-0" maximum	3/8 inch
In 40'-0" or more	3/4 inch
  - 3. Cross-Sectional Dimensions
 

Minus	1/4 inch
Plus	1/2 inch
- C. Building Lines: Variation of linear building lines from established position in plan and related position of columns, walls and partitions:
  - 1. In any bay or 10'-0" maximum 1/2 inch
  - 2. In 40'-0" or more 1 inch
- D. Slab Openings: Variations in size and location of sleeves and slab openings shall not exceed 1/4 inch.

**3.04 SURVEY AND ADJUSTMENT:**

- A. Check forms before and during placement of concrete, using an instrument, and make corrections as work proceeds.

**3.05 EMBEDDED PIPING AND ROUGH HARDWARE:**

- A. Comply with ACI. Where work of other sections require openings for passage of pipes, conduits, ducts, and other inserts in the concrete, obtain all dimensions and other information. All necessary pipe sleeves, anchors, or other required inserts shall be accurately installed as part of the work of other sections, according to following requirements.
- B. Openings: Size and locate formed openings, depressions, recesses and chases to accommodate products to be applied to, built into and pass through concrete Work. Coordinate size, location and placement of inserts, embedded products, openings and recesses with Work specified in other Sections.
- C. Anchors and Other Devices: Set and build into concrete formwork anchorage devices and other embedded products required for Work to be attached to or supported by concrete elements.
- D. Locating Embedded Products and Openings: Use setting drawings, diagrams, instructions and templates to set embedded products.
- E. Conduits or Pipes: Locate so as not to reduce strength of concrete. In no case place pipes, other than conduits, in a slab 4-1/2" thick or less. Conduit buried in a concrete slab shall not have an outside diameter greater than 1/3 the slab thickness nor be placed below the bottom reinforcing steel or over top reinforcing steel. Space conduit a minimum of 5 diameters apart.
- F. Sleeves: Pipe sleeves may pass through slabs or walls if not exposed to rusting or other deterioration and are of uncoated or galvanized iron or steel. Provide sleeves of diameter large enough to pass any hub or coupling on pipe, including any insulation.
- G. Conduits: Conduits may be embedded in walls only if the outside diameter does not exceed 1/3 the wall thickness, are spaced no closer than 3 diameters on centers, and do not impair the strength of the structure.

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H. Clusters of Conduits:

1. Clusters of conduits embedded in a concrete slab shall not exceed 6 conduits per cluster and each conduit per cluster shall be individually spaced as per the above requirements. Conduit clusters exceeding this requirement shall be reviewed and approved by the Structural Engineer of Record and Building Official prior to the installation of the conduits.
2. If more than one conduit cluster is required in a specific area of the slab, routing and spacing of the clusters shall be reviewed and approved by the structural engineer of record and Building Official prior to the installation of the conduits.
3. At no time shall the quantity and routing of clusters of conduits impair the strength of the concrete construction.

**3.06 PATCHING:**

- A. Schedule: Patch forming and tie holes immediately after form removal.
- B. Cleaning: Clean surface of all loose materials and soiling.
- C. Patching: Patch all holes and depressions with grouting gun and grout mix of one part cement and 2-1/2 parts mortar sand

**3.07 FIELD QUALITY CONTROL:**

- A. Inspection: Obtain inspection and approval of forms per CBC Table 1705A.3 Item 12 before placing structural concrete.

**END OF SECTION**

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**SECTION 03 20 00  
CONCRETE REINFORCEMENT**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Reinforcing bars for cast-in-place concrete.
  - 2. Reinforcing mesh for cast-in-place concrete.
  - 3. Reinforcing Bars for masonry.
- B. Related Work Specified Elsewhere:
  - 1. Concrete Formwork: Section 03 10 00.
  - 2. Cast in Place Concrete: Section 03 30 00.

**1.02 REFERENCES, CODES AND STANDARDS:** The following references, codes and standards are hereby made a part of this Section shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings. Latest adopted edition of references and codes adopted by the Governing Agency shall apply. Nothing contained herein shall be construed as permitting work that is contrary to code requirements.

- A. American Concrete Institute (ACI) – ACI 301, Specifications for Structural Concrete for Buildings.
- B. American Concrete Institute (ACI) – ACI 318, Building Code Requirements for Reinforced Concrete.
- C. American Concrete Institute (ACI) – 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures.
- D. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice.
- E. CRSI 63 - Recommended Practice for Placing Reinforcing Bars.
- F. CRSI 65 - Recommended Practice for Placing Bar Supports, Specifications and Nomenclature
- G. American Welding Society (AWS) – AWS D1.4, D1.1 “Structural Welding Code.”
- H. International Building Code with State of California amendments (CBC).

**1.03 SUBMITTALS:**

- A. Shop Drawings: Submit including complete layouts, sections, and details for congested conditions, typical bending diagrams and offsets, splice lengths and locations, proposed layout where vertical and horizontal bars intersect, and wherever welding is proposed, detailed to conform to AWS and CBC requirements. After approval of initial submission, subsequent submittals may be waived.
- B. Product Data.
- C. Certifications: If steel is to be welded, submit certifications signed by AWS Certified Welding Inspector (CWI) of prequalified welding procedures, qualifications of welding procedures unless prequalified, qualification of welding operators, and qualification of welders.
- D. Chemical Analysis: Provide for bars to be welded, in accordance with CBC Table 1705.3 and ACI 318 26.6.4.1.

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#### 1.04 QUALITY ASSURANCE:

- A. Source Quality Control: Refer to Section 01 40 00 for general requirements and to following paragraphs for specific procedures. Testing Laboratory shall perform following conformance testing, shall select test samples of bars, ties, and stirrups from the material at the site or from place of distribution, each sampling including at least two 18" long pieces, and perform the following tests in accordance with CBC Section 1910A.2, ASTM 615 and ASTM A706.
  - 1. Identified Bars: If samples are obtained from bundles as delivered from the mill, identified as to heat number, accompanied by mill analyses and mill test reports, and properly tagged with Identification Certificate so as to be readily identified, perform one tensile and one bend test for each 10 tons or fraction thereof of each size of bars. Submit mill reports when samples are selected.
  - 2. Unidentified Bars: When positive identification of reinforcing bars cannot be made and when random samples are obtained, perform tests for each 2.5 tons or fraction thereof, one tensile and one bend test from each size of bars.
- B. Qualification of Welds, Welding Operators, and Welders: Comply with applicable Building Code standard. Perform welding procedure qualification, except for prequalified procedures, as required by AWS D1.4, prior to executing any welding of reinforcing steel.
  - 1. Only AWS Certified Welding Inspectors shall be used for tests and qualifications associated with welding of reinforcing steel.
  - 2. Only AWS qualified welders or welding operators shall perform welding of reinforcing steel.
- C. Welding of reinforcing shall be in conformance with AWS & CBC. Do not weld reinforcing without approval of the structural engineer.
- D. Install reinforcing in accordance with ACI 318, CRSI & CBC.
- E. Coordination: Coordinate Work specified in this Section with other Sections which require placement of embedded products and provision of openings and recesses. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect (Structural Engineer) before proceeding

#### 1.05 MARKING AND SHIPPING:

- A. Bundle bars, tag with identification, and transport and store so as not to damage any material. Use metal tags indicating size, length and other marking shown on placement drawings. Maintain tags after bundles are broken.

#### 1.06 EXTRA MATERIAL:

- A. Provide and install an additional 2% of the total rebar quantity for the project in addition to the quantities shown on drawings. This additional steel shall be installed during construction, in sizes and locations as directed. Provide unit price for purpose of adjusting contract price to reflect quantity of extra material actually used. All unused material shall be credited to the owner based upon the agreed unit prices.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS:

- A. Reinforcing bars: ASTM A615, Grade 60, unless otherwise indicated on drawings. Strength performance requirements for use as noted in the drawings.
- B. Reinforcing bars for welding: ASTM A706, Grade 60.
- C. Welded steel wire fabric conforming to ASTM A1064 as indicated on the structural drawings.
- D. Shear studs: Low carbon steel, C1015 in accordance with ASTM A108.

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- E. Stud welding method in accordance with AWS D1.1.
- F. Tie wire: ASTM A1064, Annealed copper-bearing steel, 16 gauge minimum.
- G. Chairs and similar support items:
  - 1. Chairs, Bolsters, Bar Supports and Spacers: Wire-bar-type devices, complying with CRSI Manual of Standard Practice, for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Provide size and shape as required for strength and support of reinforcement during reinforcement installation and concrete placement.
    - a. Supports at Slab on Grade: Provide devices with load-bearing pads or horizontal runners where base material will not support chair legs, to prevent puncture of vapor retarder or provide precast concrete block bar supports of equal or greater strength to specified concrete.
    - b. Corrosion Resistance:
      - i. Provide plastic coated, plastic-tipped (CRSI, Class 1) or stainless steel types at exposed-to-view concrete surfaces.
      - ii. Provide only stainless steel (CRSI Class 2) at exterior exposed surfaces to be painted.
- H. Welding electrodes: AWS D1.4, Table 5.1 for low hydrogen electrodes, E9018 for Grade 60 steel, E70XX Series for grade 40 steel
- I. Mechanical Couplers or Splice Devices: Lenton, Barlock, Cadweld conforming to ACI 318.

**2.02 FABRICATION OF REINFORCING BARS:**

- A. Comply with CRSI Manual of Standard Practice for Reinforced Concrete Construction for fabrication of reinforcing steel.
- B. Bending and Forming: Fabricate bars of the indicated sizes and bend and form to required shapes and lengths by methods not injurious to materials. Do not heat reinforcement for bending. Bend bars No. 6 size and larger in the shop only. Bars with unscheduled kinks or bends are subject to rejection. Use only tested and approved bar materials.
- C. Welding: Use only ASTM 706 steel where welding is proposed. Perform welding, where shown or approved, by the direct electric arc process in accordance with AWS D1.4 using specified low-hydrogen electrodes. Preheat 6" each side of joint. Protect joints from drafts during the cooling process; accelerated cooling is prohibited. Do not tack weld bars. Clean metal surfaces to be welded of all loose scale and foreign material. Clean welds each time electrode is changed and chip burned edges before placing welds. When wire brushed, the completed welds must exhibit uniform section, smooth welded metal, feather edges without undercuts or overlays, freedom from porosity and clinkers, and good fusion and penetration into the base metal. Cut out welds or parts of welds found defective with chisel and replace with proper welding. Prequalification of welds shall be in accordance with Code. No welds shall be made at bends in reinforcing bars. Prequalification of welds shall be in accordance with AWS D1.4.
- D. Galvanizing: Hot-dip galvanize fully completed reinforcing assemblies in accordance with ASTM A123 where indicated.

**PART 3 - EXECUTION**

**3.01 INSTALLATION OF REINFORCING:**

- A. Provide additional reinforcing bars at wall and slab openings as required. Before placing bars, and again before concrete is placed, clean bars of loose mill scale, oil, or any other coating that might destroy or reduce bond.

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- B. Securing in Place: Accurately place bars and wire tie in precise position where bars cross. Bend ends of wire ties away from the forms. Wire tie bars to corners of ties and stirrups. Support bars according to the current edition of "Recommended Practice for Placing Bar Supports" of Concrete Reinforcing Steel Institute, using approved accessories and chairs. Place precast concrete cubes with embedded wire ties to support reinforcing steel bars in concrete placed on grade and in footings. Use care not to damage vapor barriers where they occur.
- C. Coordination: Locate reinforcement to accommodate embedded products and formed openings and recesses.
- D. Clearances: Maintain minimum clear distances between reinforcing bars and face of concrete as indicated on plans or directed.
- E. Splices: Do not splice reinforcing bars at the points of maximum stress except where indicated. Lap splices as shown or required to develop the full strength or stress of bars. Stagger splices in horizontal wall bars at least 24" longitudinally in alternate bars and opposite faces.
- F. Splice Devices: Install in accordance with manufacturer's written instructions.
- G. Wire Fabric Placement: Place fabric in sheets as long as practical, lapping adjoining pieces at least one full mesh plus 2", 9", or 1.5 l<sub>d</sub>, whichever is greater and tie with 16 gage wire. Offset end laps in adjacent widths to prevent continuous laps. Extend fabric to within 1-inch of edge at slabs on grade. Cut mesh at expansion joints and full depth control joints.
- H. Field Welding of Bars: As specified for fabrication.
- I. Maintaining Bars In Position: Take adequate precautions to assure that reinforcing position and spacing is maintained during placement of concrete.

### 3.02 FIELD QUALITY CONTROL:

- A. Supervision: Perform work to this section under the supervision of a capable superintendent.
- B. Inspection: Obtain inspection and approval of reinforcing before concrete is placed.
- C. Welding Inspection. Whether welding is done in the shop or at the site, perform welding of reinforcing bars under inspection of the Testing Laboratory Welding Inspector. All reinforcing welding shall have continuous inspection.
- D. Notify structural engineer approximately 48 hours prior to completion of placement.

### 3.03 CORRECTIONS DURING CONCRETE PLACEMENT:

- A. Corrections During Concrete Placement: Maintain reinforcing steel workers during placement of concrete for resetting reinforcement displaced by runways, workers and other causes.

### 3.04 DEFECTIVE WORK:

- A. Defective Reinforcement Work: The following shall be considered defective and may be ordered to be removed and reconstructed at no change in Contract Time or Sum.
  - 1. Bars with kinks or bends not shown on Drawings.
  - 2. Bars injured due to bending or straightening.
  - 3. Bars heated or bent.
  - 4. Reinforcement not placed in accordance with Drawings and Specifications.
  - 5. Rusty or oily bars.
  - 6. Bars exposed in surface of concrete.

**END OF SECTION**



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**SECTION 033000**  
**CAST-IN-PLACE CONCRETE**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. This section includes:
1. Furnishing, placing, patching, and initial curing of cast-in-place concrete unless otherwise specified.
  2. Grout and drypack, except as otherwise specified.
  3. Placing of embedded anchor bolts and inserts.
  4. Vapor barrier under interior floor slabs on grade.
  5. Finishing and final curing of cast-in-place concrete.
  6. Miscellaneous concrete work, including but not limited to areaways, cast-in-place valve boxes, pits, splash blocks, equipment bases, and other items as shown or required to complete all Work.
  7. Slurry concrete.
- B. Related Work Specified Elsewhere:
1. Preparation and grading of earth subgrade, Section 31 20 00.
  2. Concrete Paving: Concrete for pedestrian and vehicular traffic, Section 32 13 13.
  3. Furnishing, erection, and removal of forms, Section 03 10 00.
  4. Furnishing and placing reinforcing steel for cast-in-place concrete, Section 03 20 00.
  5. Reinforcing bars for masonry, Section 04 22 00.

- 1.02 REFERENCES, CODES AND STANDARDS:** The following references, codes and standards are hereby made a part of this Section work shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings. Latest adopted edition of references and codes adopted by the Governing Agency shall apply. Nothing contained herein shall be construed as permitting work that is contrary to code requirements.
- A. American Concrete Institute (ACI) ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
  - B. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
  - C. American Concrete Institute (ACI): ACI 211.2 – Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
  - D. ACI 301 Specifications for Structural Concrete for Buildings.
  - E. ACI 302.1 – Recommended Practice for Concrete Floor and Slab Construction.
  - F. ACI 304 Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
  - G. ACI 304.2 Placing Concrete by Pumping Methods.
  - H. ACI 305 Hot Weather Concreting.
  - I. ACI 306 Cold Weather Concreting.
  - J. ACI 308 – Recommended Practice for Curing Concrete.
  - K. ACI 309 Standard Practice for Consolidation of Concrete.
  - L. ACI 315 Details and Detailing of Concrete Reinforcement.
  - M. ACI 318 Building Code Requirements for Reinforced Concrete.
  - N. ACI 347 Recommended Practice for Concrete Formwork.

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- O. American Welding Society (AWS) AWS D1.4 Structural Welding Code – Reinforcing Bars.
- P. National Ready Mixed Concrete Association (NRMCA) - Concrete Plant Standards and Truck Mixer and Agitator Standards.
- Q. Concrete Reinforcing Steel Institute (CRSI) – Manual of Standard Practice.
- R. CRSI – Placing Reinforcing Bars.
- S. International Concrete Repair Institute (ICRI) - Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion (Guideline No. 03730)
- T. IRCI - Guide for Selecting Application Methods for Repair of Concrete Surfaces (Guideline No. 03731).
- U. International Building Code (IBC) with State of California Amendments (CBC).

**1.03 SUBMITTALS:**

- A. Allow a minimum of two weeks for review of submittals.
- B. Shop Drawings: Submit for structural concrete and concrete slabs showing dimensioned locations, types of construction and expansion joints, and method of keying. Allow a minimum of two weeks for review of submittals.
- C. Mix Designs: Submit mix designs for review and approval. Allow a minimum of two weeks for review of submittals. Also refer to Section 1.05.
- D. Product Data: Proprietary admixtures, curing compounds, hardeners and sealers.
  - 1. Indicate compatibility of curing compounds and floor sealer with bond breaker for tilt-up concrete and finish materials to be applied to concrete.
  - 2. Indicate compatibility of curing compounds, hardeners and sealers with materials used for installation of applied flooring.
- E. Product Data: Submit the coloring admix manufacturer's technical data for products, methods, and color control procedures.
- F. Certificates: Certify that materials meet requirements of paragraph "Quality Assurance".
- G. Delivery Tickets: With each transit truck, provide delivery ticket, signed by an authorized representative of the batch plant, containing all information required by ASTM C94, as well as time batched, type and brand of cement, cement content, maximum size of aggregate and total water content.

**1.04 QUALITY ASSURANCE:**

- A. Compliance with Regulations: All materials shall comply with the current rules and regulations of the local air quality management district, with the rules regarding volatile organic compounds, and with FDA rules and regulations for dangerous substances in construction products.
- B. Concrete Manufacturer: Furnish concrete from licensed commercial ready-mix concrete plants conforming to ASTM C94 and approved by Building Official. Requirements herein govern when exceeding ASTM C94.
- C. Allowable Tolerances: Construct concrete conforming to the tolerances specified in ACI 117 "Recommended Tolerances for Concrete Construction and Materials", as applicable, unless exceeded by requirements of regulatory agencies or otherwise indicated or specified.
- D. Testing Agency Services: Owner will engage an independent testing and inspection agency to conduct tests and perform other services specified for quality control during construction.

- E. Source Quality Control: Refer to the following paragraphs for specific procedures. Concrete materials which, by previous tests or actual service, have shown conformance may be used without testing when so approved by the Architect and Building Official. Testing Laboratory shall perform following conformance testing.
1. Portland Cement: Furnish Certificate of Compliance acceptable to Architect and Building Official, showing conformance with requirements specified; otherwise, the Testing Laboratory shall test each 250 barrels of cement in accordance with ASTM C150.
  2. Aggregate for Normal Weight Concrete: Test the aggregate before and after concrete mix is designed and whenever character of aggregate varies or source of material is changed. Include a sieve analysis. Obtain samples of aggregates at the dry batching or ready-mix concrete plant in accordance with ASTM D75 and perform tests for the properties listed in the following table:

PHYSICAL PROPERTIES		
Physical Properties, units	Test Method	Minimum values
Sieve analysis	ASTM C136	Per ASTM C33 Section 6 for fine aggregate and Table 2 for coarse aggregate.
Organic impurities	ASTM C40	Fine aggregate not darker than reference standard color
Soundness	ASTM C88	Loss after 5 cycles not more than 8 percent of coarse aggregate, nor more than 10 percent of fine aggregate
Abrasion	ASTM C131	For coarse aggregate weight loss not more than 10.5 percent after 100 revolutions, 42 percent after 500 revolutions
Deleterious materials	ASTM C33	Per ASTM C33 Table 1 for fine aggregate and Table 3 for coarse aggregate
Materials finer than No. 200 sieve	ASTM C117	Not over 1 percent for gravel, 1.5 percent for crushed aggregate
Reactivity potential	ASTM C227, C289, C342	Ratio of silica released to reduction in alkalinity not to exceed 1.0.
Sand equivalent	ASTM D2419	California sand equivalent values operating range not below 71 percent

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**1.05 CONCRETE MIX DESIGNS:** Testing Laboratory shall design concrete mixes for concrete requiring 28-day compressive strength exceeding 2,500 psi. Contractor shall bear all costs for concrete mix designs. All mix designs shall be signed and sealed by a Civil Engineer registered in the State of California.

- A. **Strength Requirements:** Design mixes for structural concrete for minimum 28-day compressive strengths required by Drawings and Specifications. All mix designs for structural concrete shall be proportioned in accordance with ACI 301. If trial batches are used, the trial batch strength for each mix shall exceed indicated or specified strength by an amount based on the standard deviations of strength test records according to ACI 318.
- B. **Normal Weight Concrete Mix Designs:** Design all mixes for workability and durability of concrete. Control the mixes in accordance with ACI 211.1, "Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete", and ACI 318. Make adjustments in cement content required for concrete strengths at Contractor's expense and do not exceed 0.60 absolute water-cement or cement plus fly ash ratio by weight. Do not use calcium chloride or any admixture containing such material. Admixtures containing a material releasing nitrates in solution are limited to 0.06 percent by weight for the chloride ion.
- C. **Maximum Aggregate Sizes:** Not exceeding 3/4 of minimum clear space between bars and between bars and forms, nor larger than 1/5 of least dimensions between the forms. Design the mixes with 3/4" maximum size, except maximum 1-1/2" size for foundations and maximum 3/8" size at congested reinforcing or thin sections, when approved by the Architect.
- E. **Air Content:** All formed normal weight concrete may contain an air-entraining agent producing air content of 1.5% to 3% by volume and adjusted for weather conditions. All interior slabs shall have a maximum air content of 1.5 percent.
- F. **Pumped Concrete:** Design concrete mixes specifically for pump placing with dry loose volume of fine aggregates not more than 47 percent of total aggregates.

**1.06 DELIVERY, STORAGE, AND HANDLING:**

- A. Deliver all materials in timely manner to ensure uninterrupted progress of the Work.
- B. Store materials by methods that prevent damage and permit ready access for inspection and identification.
- C. **Runoff:** Prevent run off of water contaminated by construction agents and chemicals from soiling existing surfaces and from contaminating existing and future landscape areas.

**1.07 PROJECT SITE CONDITIONS:**

- A. Do not place concrete during rain or adverse weather conditions without means to prevent all damage. Conform to requirements specified hereinafter whenever concrete placement is required during cold or hot weather.

**PART 2 - PRODUCTS**

**2.01 MATERIALS:**

- A. **Portland cement:** ASTM C150, Type II, low alkali, or Type V when in contact with soils. Do not change brand or source without prior approval.

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B. Aggregates:

1. Standard weight aggregates: ASTM C33, from approved pits, free from vegetable matter and of opaline, feldspar, or siliceous magnesium substances; all washed, clean, hard, fine-grained sound crushed rock or gravel; not over 5 percent by weight of flat, thin, elongated, friable, or laminated pieces (pieces having major dimension over 5 times average dimension) or more than 2 percent by weight of shale or cherty material.

C. Admixtures:

1. Chemical (Water Reducing) Admixture: ASTM C494, Type A, D, or E. Only one brand. When used, are subject to approval of Architect, and should reduce the mixing water at least 5 percent without entraining air in excess of 2 percent by volume. If the water reducing agent entrains more than 2 percent air, the water reduction shall be at least 10 percent, but in no case shall the water reducing agent entrain air in excess of 4 percent.
2. Air-entraining admix: ASTM C260.
3. Pozzolan: ASTM C618, Class F or C Fly Ash, 100 pounds maximum per cubic yard, containing 1 percent or less carbon. Fly ash shall not be used in excess of 20 percent by weight of total cement quantity. Comply with DSA IR 19-3 when fly ash percentage is greater than 15%.
4. Super-Plasticizers (High Range Water Reducers): ASTM C494, Type F or G. Master Builders "Rheobuild", Euclid "Eucon 37" or equal, capable of producing concrete which can be placed at 6-8 inch slump without segregation, capable of maintaining slump within 2" of that initially mixed for 90 minutes, and of maintaining concrete temperature within 2 degrees F. from time of batching for 90 minutes minimum.
5. Color Admixture: L.M. Scofield Company "Chromix", "Colorfull Concrete Color" by Admixtures, Inc., Irwindale, Calif., both standard and retarder types as required for the field placing conditions, or prior approved equal.

D. Water: From potable domestic source.

E. Curing Materials:

1. Curing, Hardening and Sealing Materials, General: Provide materials suitable for concrete finish and not detrimental to materials to be applied to concrete. Materials shall be compatible with concrete admixtures, shall be recommended by manufacturer for intended use and shall comply with applicable air quality requirements of authorities having jurisdiction
2. Liquid Curing compound: ASTM C309, Type I, Class B, W.R. Meadows 1100 Series, Master Builders "Masterkure-N-Seal W", or equal, complying with Rule 1113 of the South Coast Air Quality Management District and Federal Air Quality Regulation 40 CFR 52.254.
3. Curing sheet: ASTM C171, non-staining white types.
4. Curing, Hardening and Dustproofing Compound: Sonneborn Sonosil, water-based inorganic silicate-base compound, to cure, harden and dustproof concrete, VOC-compliant.
5. Surface Hardening and Dustproofing Compound: Sonneborn Lapidolith concrete hardening compound, chemically-active solution which interacts with free lime in concrete to form dense, impervious wearing surface, VOC-compliant.

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- F. Vapor barrier:
1. Vapor Retarder must have the following qualities:
    - a. Water Vapor Transmission Rate: ASTM E96 with 0.04 Perms or lower.
    - b. Water Vapor Retarder: ASTM E 1745 meeting or Class C minimum.
    - c. Thickness of Retarder (plastic): ACI 302.1R-04 not less than 10 mils.
  2. Acceptable Products:
    - a. Stego Wrap 10-mil Vapor Retarder by Stego Industries LLC.
    - b. Griffolyn T-85 by Reef Industries.
    - c. Moistop Ultra by Fortifiber Industries.
  3. General Installation:
    - a. Overlap joints 6 inches and seal with manufacturers tape.
    - b. Seal all penetrations (including pipes) per manufacturer's instructions.
    - c. Repair all damaged areas prior to pouring of slab.
- G. Non-shrink grout: Conform to Corps of Engineers CRC-C 621, ASTM C1107 and as follows:
1. Metallic for concealed areas: Master Builders "Embeco 885", or equal, non-gas-forming and free of oxidizing catalysts and inorganic accelerators, used as dry or damp pack, or mixed to a 20-second flow, without segregation or bleeding at any temperature between 45 degrees F and 100 degrees F. Working time 30 minutes or more.
  2. Non-metallic for exposed areas: Master Builders "Masterflow 928", or Euclid "Euco Hi-Flow Grout" with same characteristics as specified for concealed areas.
  3. Epoxy grout where indicated: Multi-component, premeasured, fast-curing combination of thermosetting resins and inert fillers, Master Builders "Masterflow 648CP Plus", Sikadur 42 Industrial Group-Pak by Sika Chemical Corporation, or Euclid "Euco High Strength Grout".
- H. Drypack: Field mixture of 1 part Portland cement to 2 parts fine aggregate mixed to a damp consistency such that a ball molded in the hands will stick together and hold its shape. At Contractor's option, the specified admixture may be added for increased workability at lower water/cement ratio. In lieu of field mixing, Contractor may use factory mixed drypack material, such as Master Builders "Set Grout" or Euclid "Euco Dry Pack Grout".
- I. Expansion Joint Filler: Asphalt impregnated fiber or non extruding foam type, conforming to ASTM D1751 and D1752, W.R. Meadows "Sealtight", or equal.
- J. Construction Joint Materials: "Key-Kold" or "Kwik-Joint", of profiles indicated.
- K. Bonding Agent: "Weld-Crete", manufactured by Larsen Products Co., P.O. Box 2127, Rockville, MD 20852, Master Builders "Concresive", or equal.

## 2.02 CONCRETE MIXING:

- A. Furnish ready-mixed concrete from an approved commercial off-site plant. Conform to ASTM C94, except materials, testing, and mix designs as specified herein. Use transit mixer trucks equipped with automatic devices for recording number of revolutions of drum.
- B. Admixtures: All approved admixtures shall be introduced into the concrete at the batch plant. Field additions are not acceptable.
- C. Slump: Adjust quantity of water so concrete at point and time of placing does not exceed the following slumps when tested according to ASTM C143. Use the minimum water necessary for workability required by part of structure being cast.

SLUMP AND WATER/CEMENT RATIOS		
Part of Structure	Maximum Slump Inches*	Maximum Water-Cement Ratio
Footings, foundation walls, and mass concrete, not reinforced	4	0.55
Slabs on grade, reinforced and non-reinforced	4	0.45
Reinforced concrete walls	4	0.5
Concrete fill on metal deck	4	0.55
All other concrete	4	0.5

\*If super-plasticizers are used, slumps may be 6"-8" for all concrete, with water-cement ratio unchanged or lower than slumps without admixture.

### 2.03 SLURRY CONCRETE:

- A. Slurry concrete shall conform to requirements of this section for regular concrete, except that testing will not be required. Slurry concrete shall contain not less than 2 sacks of cement per cubic yard. Aggregate may be material selected from excavation, free from organic matter, or imported fill, conforming to the following gradation:

Sieve Size	Percent passing
1-1/2"	100
1"	80 - 100
3/4"	60 - 100
3/8"	50 - 100
No. 4	40 - 80
No. 100	10 - 40

- B. Water shall be added to produce a fluid, workable mix that will flow and can be pumped without segregation of aggregate. Materials shall be mechanically mixed until the cement and water are thoroughly dispersed.

## PART 3 - EXECUTION

### 3.01 PREPARATION FOR CONCRETE PLACING:

- A. Remove all free water from forms before concrete is deposited. Remove hardened concrete, debris, and foreign materials from interior surfaces of forms, exposed reinforcing, and from surfaces of mixing and conveying equipment.
- B. Wetting: Wet wood forms sufficiently to tighten up cracks. Wet other materials sufficiently to reduce adsorption and to help maintain concrete workability.

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- C. Earth Subgrade: Dampen 24 hours before placing concrete, but do not muddy. Re-roll where necessary for smoothness and remove loose material.
- D. Gravel Fill: Recompact disturbed gravel and bring to correct elevation.
- E. Sand Beds or Subslab Drainage Fill: Recompact disturbed material and bring to correct elevation.
- F. Vapor Barrier: Install under interior floor slabs on grade. Lap joints 6" in the direction of concrete spreading and tape seal. Seal the joints at walls and around penetrations with tape. Cover barrier with 2" layer of clean damp sand.
- G. Screeds: Set screeds at walls and maximum 8-foot centers between. Set to provide level floor. Check with an instrument level, transit, or laser during placing operation to maintain level floor.
- H. Screeds over Vapor Barrier: Use weighted pad or cradle type screeds and do not drive stakes through the vapor barrier. Check with an instrument level, transit, or laser.
- I. Expansion Joint Filler: Install where slabs abut buildings and elsewhere as indicated. Install full depth of concrete with top level with finished surface of concrete.
- J. Metal Floor Decking: Verify that decking joints are sealed and there are no openings or voids that will permit concrete leakage.
- K. Composite Steel Beams: Provide shores for tributary construction loads to floor and roof beams as required, or camber the beams as approved by Architect.

### 3.02 CONCRETE PLACING:

- A. Conveying and Placing: Comply with ACI 304. Do not place concrete until the reinforcing steel, embedded items, forms, or metal decking have been approved. Do not use aluminum tubes or any aluminum equipment for pumping concrete, nor allow concrete to free fall from its point of release at mixer, hoppers, tremies, or conveying equipment more than 5 feet for concealed concrete and 3 feet for exposed concrete. Deposit concrete in 18" maximum lifts within 90 minutes after water is first added to the batch and so that the surface is kept level throughout, a minimum being permitted to flow from one portion to another. Place concrete by methods that prevent segregation of materials.
  - 1. Where new concrete is placed against or on old or existing concrete, apply bonding agent to properly prepared surface of old concrete prior to placement of new concrete. Prepare surface in accordance with ICRI.
  - 2. Exception: When using super-plasticizers, the free fall, horizontal layer thickness and time limitations may be doubled.
- B. Placement in Forms: Limit horizontal layers to depths which can be properly consolidated, but in no event greater than 24 inches.
  - 1. Consolidate concrete by means of mechanical vibrators, inserted vertically in freshly placed concrete in a systematic pattern at close intervals. Penetrate previously placed concrete to ensure that separate concrete layers are knitted together.
  - 2. Vibrate concrete sufficiently to achieve consistent consolidation without segregation of coarse aggregates.
  - 3. Do not use vibrators to move concrete laterally.
- C. Protection: Ensure that reinforcement, embedded products, joint fillers and joint devices are not disturbed during concrete placement.



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- D. Joints in Concrete: Locate construction joints only where approved, and obtain prior approval for points of stoppage of any pour. Clean and roughen the surface of construction joints by removing the entire surface and exposing 1/4" amplitude of clean aggregate solidly embedded in mortar matrix by sandblasting, chipping, use of an approved surface retarder, or equal. Water and keep hardened concrete wet for not less than 24 hours and slush with portland cement slurry just before placing joining concrete. Cover horizontal surfaces of existing or previously placed and hardened concrete with a 2" thick layer of fresh concrete less 50% of coarse aggregate just before balance of concrete is placed.
- E. Vertical Elements: Stop placement of concrete in walls and columns 1-1/2" below bottom of beams or supported slabs. Stop placement at sills and heads of wall openings in the same manner. Allow concrete in vertical elements to be in place at least 2 hours and until vertical settlement has ceased before placing concrete for floor framing.
- F. Compacting: Compact each layer of the concrete as placed with mechanical vibrators or equivalent equipment. Transmit vibration directly to concrete and in no case through the forms unless approved. Accomplish thorough compaction. Supplement by rodding or spading by hand adjacent to forms. Compact concrete into corners and angles of forms and around reinforcement and embedded fixtures. Recompact deep sections with congestion due to reinforcing steel as required.
- G. Operation of Vibrators: Do not horizontally transport concrete in forms with vibrators nor allow vibrators to contact forms or reinforcing. Push vibrators vertically into the preceding layers that are still plastic and slowly withdraw, producing maximum obtainable density in concrete without creating voids or segregation. In no case disturb concrete that has partially set. Vibrate at intervals not exceeding two-thirds the effective visible vibration diameter of the submerged vibrator. Avoid excessive vibration that causes segregation. Use and type of vibrators shall conform to ACI 309 "Recommended Practice for Consolidation of Concrete".
- H. Correction of Segregation: Before placing next layer of concrete, and at the top of last placement for vertical elements, remove concrete containing excess water or fine aggregate or showing deficiency of coarse aggregate and fill the space with compacted concrete of correct proportions.
- I. Waterproof Membranes: Perform work adjacent to waterproof membranes to prevent damage to membranes. Arrange work so that membrane is left unprotected for minimum period of time, as approved. Prior to placing concrete, inspect the membrane and arrange for repair to all damage which may have occurred.
- J. Concrete Encased Columns: Clean columns as specified for cleaning other steel in contact with concrete. When concrete is not carried to structure above, stop concrete perpendicular to column axis at the same elevation on all parts of all columns in the space. Float top neatly to column.
- K. Slabs:
1. Float Finish: Place, consolidate, strike off and level concrete slab to proper elevation. Use highway straightedge, bull float or darby. Remove all bleed water. After the concrete has stiffened sufficiently to permit the operation, and water sheen has disappeared, the surface shall be floated, at least twice, to a uniform sandy texture. Remainder of finishing operations shall be as specified in Section 03 34 50 for each type of surface.
  2. On-Grade Slabs: Place with maximum 40-foot edge dimension. Generally locate joints on column lines, exact locations as directed or approved.
  3. On-Grade Slab Construction and Contraction Joints: Use types as indicated at column lines intermediate locations.

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4. Expansion Joints: Conform to details and approved submittal. Provide expansion joint filler finished flush with slab surface except for those joints shown to be sealed with sealant. Conform to Section 07 92 00 where sealant sealed joints are shown or specified, including the polymer joint filler, backing, and bond breaker.
5. Control Joints: Provide for concrete slabs as indicated. At Contractor's option, "Soff-Cut" saw may be used to depth of 1-1/4" immediately providing spalling or undercutting of the concrete does not occur, and in no case shall slab reinforcement be cut or damaged. Conventional saws shall be used as soon as possible without dislodging aggregate to 1/4 slab thickness. Complete sawing of joints within 12 hours after finishing is completed. If early sawing causes undercutting or washing of the concrete, delay the sawing operation and repair the damaged areas. The saw cut shall not vary more than 1/2 inch from the true joint alignment. Discontinue sawing if a crack develops ahead of a saw cut. Immediately after each joint is sawed, thoroughly clean the saw cut and adjacent concrete surface. Respray surfaces treated with curing compound which are damaged during the sawing operations as soon as the water disappears. Protect joints in a manner to prevent the curing compound from entering the joints.

### 3.03 COLD WEATHER PROVISIONS:

- A. Conform to ACI 306 and the following requirements.
- B. Normal Concrete: When the temperature is below 40 degrees F. the temperature of the concrete placed in the forms shall be at least 60 degrees F. When the temperature is below 30 degrees F. the temperature of the concrete as mixed shall be 65 degrees F. In all cases, when the daily average temperature is below 40 degrees F. the concrete shall be kept at 55 degrees F. for 72 hours and then allowed to drop uniformly to the air temperature over the next 24 hours.
  1. Concrete temperature shall be measured by placing a thermometer 2" from the top of the concrete being placed.
- C. Air-entrained concrete shall be kept at the above temperature for 27 hours and above freezing for an additional 72 hours.
- D. No calcium chloride shall be used to accelerate hardening of concrete. Contractor to certify that any additive used does not contain calcium chloride.
- E. If low temperature accelerating admixture is proposed, adjust concrete mix as required and obtain approval of Architect.
- F. All concrete materials, reinforcement, forming materials and ground with which concrete is to come in contact shall be free of frost.
- G. The covering or other protection used in connection with the curing shall remain in place and intact for at least 24 hours.
- H. The work shall be protected from the elements, flowing water, and defacements of any nature during the construction operations.

### 3.04 HOT WEATHER PROVISIONS:

- A. Conform to ACI 305 and the following requirements.
- B. Take extra care to reduce the temperature of the concrete being placed, and to prevent rapid drying of newly placed concrete. When the outdoor ambient temperature is more than 90 degrees F., shade the fresh concrete as soon as possible after placing, and start curing as soon as the surface of the fresh concrete is sufficiently hard to permit it without damage. Using retarding admixture at 85°F or higher.

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- C. Concrete placement temperatures shall be controlled by the Contractor and shall not be limited to:
  - 1. Shading and cooling the aggregate;
  - 2. Avoiding use of hot cement;
  - 3. Cooling mixing water by additions of ice;
  - 4. Insulating water supply lines and tanks; and
  - 5. Insulating mixer drums or cooling them with sprays or wet burlap.
- D. Unexposed Form Finish: Repair tie holes and patch defective areas. Rub down or chip off fins or other raised areas exceeding 1/4-inch height.
- E. Exposed Form Finish: Repair and patch defective areas, with fins or other projections completely removed and smoothed.
  - 1. Grout cleaned finish: Apply to surfaces indicated after all contiguous surfaces are accessible; do not clean as work progresses.
    - a. Prepare grout using 1 part portland cement, 1-1/2 parts fine sand, and enough water to produce a mixture with consistency of thick paint. Achieve grout color matching concrete surface color by blending normal and white portland cements.
    - b. Wet areas to be cleaned and apply grout mixture evenly by brush or spray. Scrub surface immediately after grout application to fill minor air bubbles, using cork float or stone, and remove excess grout while it is still plastic. After initial drying, rub surface vigorously with clean burlap, and keep moist for not less than 36 hours.
  - 2. Contiguous unformed surfaces: Strike smooth and float to a similar texture tops of walls, horizontal offsets, and other unformed surfaces adjacent to or contiguous with formed surfaces. Continue final finish of formed surfaces across unformed surfaces, unless otherwise specifically indicated.

### 3.05 FINISHING SLABS:

- A. Interior Floor and Exterior Slab Finishes and Tolerances, General: See SCHEDULE in Section 3.17 of this specification for finishes. Achieve flat, level planes except where slopes or grades are indicated. Tolerances shall be in accordance with FF (flatness) and FL (levelness) as defined in ACI 117.
- B. Finishing Operations, General: Do not directly apply water to slab surface or dust with cement. Use hand or powered equipment only as recommended in ACI 302.1.
- C. Screeding: Strikeoff to required grade and within surface tolerances indicated. Verify conformance to surface tolerances. Correct deficiencies while concrete is still plastic.
- D. Bull Floating: Immediately following screeding, bull float or darby before bleed water appears to eliminate ridges, fill in voids, and embed coarse aggregate. Recheck and correct surface tolerances.
- E. Final floating: Do not perform subsequent finishing until excess moisture or bleed water has disappeared and concrete will support either foot pressure with less than 1/4-inch indentation or weight of power floats without damaging flatness.
  - 1. Float to embed coarse aggregate, to eliminate ridges, to compact concrete, to consolidate mortar at surface, and to achieve uniform, sandy texture.
  - 2. Recheck and correct surface tolerances.
- F. Troweling: Trowel immediately following final floating.
  - 1. Apply first troweling with power trowel except in confined areas, and apply subsequent trowelings with hand trowels.

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2. Wait between trowelings to allow concrete to harden. Do not over-trowel.
3. Begin final troweling when surface produces a ringing sound as trowel is moved over it. Consolidate concrete surface by final troweling operation. Completed surface shall be free of trowel marks, uniform in texture and appearance, and within surface tolerance specified.
4. Grind smooth surface defects which would telegraph through final floor covering system.

G. Finishes:

1. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile on mortar bed, and paint or another thin film-finish coating system. Grind smooth any surface defects that would telegraph through applied floor covering system.
2. Trowel and Burnished Finish: In warehouse storage and materials handling areas, at exposed concrete floor slab, trowel finish as specified above with burnishing in compliance with Class 5 requirements according to ACI 301, without topping.
3. Non-Slip Broom Finish: Apply a non-slip broom finish to troweled finish at exterior concrete platforms, steps, and ramps, and elsewhere as indicated. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route.

H. Repair of Slab Surfaces: Test slab surfaces for smoothness and to verify surface plane to tolerance specified. Repair defects as follows:

1. High areas: Correct by grinding after concrete has cured for not less than 14 days.
2. Low areas: Immediately after completion of surface finishing operations, cut out low areas and replace with fresh concrete. Finish repaired areas to blend with adjacent concrete. Proprietary patching compounds may be used when approved by the Architect or Structural Engineer.
3. Crazed or cracked areas: Cut out defective areas, except random cracks and single holes not exceeding 1-inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts. Dampen exposed concrete and apply bonding compound. Mix, place, compact, and finish patching concrete to match adjacent concrete.
4. Isolated cracks and holes: Groove top of cracks and cut out holes not over 1-inch in diameter. Dampen cleaned concrete surfaces and apply bonding compound; place dry pack or proprietary repair compound acceptable to Architect or Structural Engineer while bonding compound is still active:
  - a. Dry-pack mix: One part portland cement to 2-1/2 parts fine aggregate and enough water as required for handling and placing.
  - b. Install patching mixture and consolidate thoroughly, striking off level with and matching surrounding surface. Do not allow patched areas to dry out prematurely

**3.06 CONCRETE CURING AND SEALING:**

A. Curing, General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Use curing method compatible with applied finishes, waterproofing and other coatings. When coatings or waterproofing are to be applied to concrete or when concrete is intended to remain exposed, use moist curing (sheet) method only. See Schedule at end of this Section.

1. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material.

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2. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days, or as recommended by manufacturer.
  3. Apply curing compounds after screeding and bull floating, but before power floating and troweling.
  4. Apply sealer hardener compounds as scheduled at end of this Section.
- B. Application of Liquid and Dust-On Agents: Apply agents in accordance with manufacturer's instructions and recommendations.
- C. Curing, Floors and Slabs: Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:
1. Floor slabs to receive concrete floor topping or mortar setting beds for ceramic tile or stone tile: Curing compound or moist cure.
  2. Floor slabs to receive adhesively-applied resilient flooring or carpet: Moist cure or curing/hardening and dustproofing compound (compatible with flooring adhesives) when acceptable to Architect or Structural Engineer. Coordinate moist curing with flooring application requirements and provide sealer as necessary to avoid detrimental affect of dusting.
  3. Floor slabs to receive waterproof membrane or thinset ceramic tile: Moist cure only.
  4. Floor slabs to remain exposed and receive only light traffic (electrical rooms and equipment rooms): Curing, hardening and dustproofing compound or moist cure. If moist cure, apply one coat of surface hardening and dustproofing compound as specified for other exposed floor slabs.
  5. Floor slabs to remain exposed and receive normal pedestrian and light vehicle traffic: Moist cure. Apply specified sealers or surface hardening compound as scheduled at end of this Section.
  6. Equipment pads and bases: Match surrounding floor.

### **3.07 PATCHING FORMED CONCRETE:**

- A. Remove fins, projections, and offsets. Cut out rock pockets, honeycomb, and all other defects to sound concrete, with edges of cuts straight and back-beveled. Dampen cut-outs and edges, and scrub with neat portland cement slurry just before patching, or an apply approved epoxy concrete adhesive.
- B. Saturate form tie holes with water and fill voids and patches with flush smooth-finished mortar of same mix as concrete (less coarse aggregate), cure, and dry.

### **3.08 MISCELLANEOUS CONCRETE ITEMS:**

- A. Filling In: Fill in holes and openings left in concrete structures for passage of Work specified in other Sections, after such Work is in place. Mix, place, and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

### **3.09 GROUTING AND DRYPACKING:**

- A. Install as indicated or required. Where grouting and drypacking is part of the work of other sections, it shall conform to the following requirements, as applicable.

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- B. Drypacking: Mix materials thoroughly with minimum amount of water. Pre-saturate surfaces to receive dry pack for 24-hours prior to placement, install drypack by forcing and rodding to fill voids and provide complete bearing under plates. Finish exposed surfaces smooth and cure with damp burlap or liquid curing compound.
- C. Non-Shrink Grouting:
  1. Mixing: Mix the approved non-shrink grout material with sufficient water per manufacturer's recommendations.
  2. Application: Surfaces to receive the non-shrink grout shall be clean, and shall be pre-saturated thoroughly 24-hours before placing the mortar. Before grouting, surfaces to be in contact shall be roughened and cleaned thoroughly, all loose particles shall be removed and the surface flushed thoroughly with neat cement grout immediately before the grouting mortar is placed. Place fluid grout from one side only and puddle, chain, or pump for complete filling of voids; do not remove the dams or forms until grout attains initial set. Finish exposed surfaces smooth, and cure as recommended by grout manufacturer.

**3.10 SITE CONCRETE WORK:**

- A. Use bituminous type joint filler. Cure all concrete for at least 10 days with liquid curing compound or sheet material except as otherwise specified. Construct all site concrete of 2,000 psi concrete unless otherwise indicated or specified. Provide reinforcing bars or mesh only where indicated. Conform to requirements specified hereinbefore for slab finishing and curing as applicable.
- B. Concrete Curbs: Provide 1/2" thick expansion joints, at beginning and at end of curves, intersections, and 20-foot intervals between, set plumb, square, and to same profile as the curbs. Edge curb tops to 1/2" radius and vertical joints to 1/4" radius. Apply smooth finish followed by fine hair brush finish.
- C. Concrete Gutters: Provide 1/2" thick expansion joints as above for curbs and apply a light broom finish with a 3" wide steel trowel finish at flow line.
- D. Combination Curb and Gutter: As above for curbs and gutters, including expansion joints, 3" troweled flow line at base of curb.
- E. Concrete Walks: Provide 1/2" expansion joints as specified for curbs and where walks abut rigid structures, aligned with joints in curbs where adjoining, and apply light broom finish perpendicular to traffic direction. Score walks as shown or directed.
- F. Control Joints: Provide sawed joints for concrete walks and exterior concrete pavement as indicated. Use "Zip Strip" as distributed by S.C.A. Construction Supply, Santa Fe Springs, Calif., or equal only where specifically indicated. Install tops of the joints flush with the concrete surface and depth of joint a minimum of 1/4 the thickness of slab.

**3.11 OFF-SITE CONCRETE WORK:**

- A. Provide new concrete items where indicated, and replace existing items damaged by Contractor's operations. Secure and pay for required permits, inspections, engineering, and surveying.

**3.12 SLURRY CONCRETE:**

- A. Slurry concrete shall be used as fill or backfill where indicated, and wherever excavations are carried below design depths without approval. Slurry concrete shall be placed within 1 hour after mixing, and shall be placed in manner that will prevent voids in, or segregation of, the concrete.
- B. Backfilling over slurry concrete shall not be done less than 4 hours after placing.

**3.13 FIELD QUALITY CONTROL:**

- A. Level of Floors: Continuously monitor concrete placing to maintain level floor by use of an instrument level, transit, or laser

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- B. Delivery tickets: Have available copies of delivery tickets complying with ASTM C94 for each load of concrete delivered to site. Include on the tickets the additional information specified in the ASTM document.
- C. Continuous Inspection: Construct structural concrete exceeding 2,500 psi compressive strength under continuous inspection of Inspector. Obtain inspection and approval of forms and reinforcing by Building Department as required and by the Inspector before placing structural concrete.
- D. Testing of Concrete: Testing Laboratory shall perform the following tests. Samples for testing shall be obtained in accordance with ASTM C172 and shall be taken from as close to point of placement as possible.
  - 1. Compressive Strength Tests: Cast one set of four or more cylinders from each day's placing and each 150 cubic yards, or fraction thereof, or not less than once for each 5,000 square feet of surface area for slabs and walls, of each strength of structural concrete. Date cylinders, assign record number, and tag showing the location from which sample was taken. Also record slump test result of sample. Do not make more than two series of tests from any one location or batch of concrete.
  - 2. Slump Tests: Make slump test for each set of test cylinders.
  - 3. Test Cylinders: Samples will be made in accordance with ASTM C172. Cast cylinders according to ASTM C31; 24 hours later, store cylinders under moist curing conditions at about 70 degrees F. Test according to ASTM C39; one at 7 and two at 28 day ages. The remaining cylinder(s) shall be kept in reserve in case tests are unsatisfactory.
  - 4. Control Test Cylinders: Cast a set of two or more cylinders for each day's placing of concrete for slabs supported on shoring. Place test cylinders on slabs represented by cylinders and cure the same as slabs. Test cylinders to determine proper times for removal of shores and reshoring. A strength test shall be the average of the compressive strengths of 2 cylinders made from the same sample of concrete and tested at 28 days.
  - 5. Shrinkage Test: Cast 4" by 4" by 11" long bars with 10" effective gauge length, cured for 7 days in moist room and as specified in ASTM C157. Make measurements at 7-day intervals to 35 day age. Allowable shrinkage shall not exceed 0.045% after period of 35 days.
- E. Core Tests: comply with ACI 318. If tests show the compressive strength of any concrete falls below the required minimum, additional testing of concrete which unsatisfactory tests represent may be required. Make core tests according to ASTM C42. Fill core holes with drypack concrete of strength required for concrete. Contractor shall bear cost of tests for below-strength concrete even if such tests indicate concrete has attained required minimum compressive strength, and all costs for required corrections.
- F. Field Certifications: For all concrete, provide signed copy of batch plant's certificate stating quantity of each material, amount of water, admixtures, departure time and date accompanying each load of materials or concrete.
- G. Local Flatness/Levelness Tests: When and if directed by Owner, concrete floor flatness and levelness shall be tested in conformance to ACI 117 for Face Floor Profile Numbers (FF and FL designations) specified.
  - 1. Tests will be made by an independent testing and inspection agency selected and paid by Owner.
  - 2. Floor flatness and levelness measurements will be determined by a continuous recording differential profileograph.
  - 3. On each newly placed and finished floor, testing and reporting will be as follows:
    - a. Within 16 hours of completion of final troweling operation, floor tolerance measurements will commence.

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- b. Within 18 hours of completion of final troweling operation, Contractor will be provided with written notice of acceptance or rejection of floor slab.
  - c. Within 24 hours of completion of final troweling operation, Owner's testing and inspection agency will mark floor areas to indicate defective areas which require corrective Work.
  - d. Within 3 working days of completion of final troweling operation, measurements of overall grade tolerance will be made and the results provided to Contractor not later than 7 working days from date of completion of final troweling.
  - e. Weekends and holidays shall be excluded in computing time from completion of final troweling operation.  
Example: Final troweling operation completed at 5:00pm Thursday; notice of acceptance or rejection due 11:00am Friday.  
Example: Final troweling operation completed at 5:00pm Friday; notice of acceptance or rejection due 11:00am Monday.
4. Correction of Flatness and Levelness Defects: Flatness and levelness defects in concrete floors shall be corrected by grinding or by removal and replacement of defective floor slab. Filling of low areas will not be accepted for concrete floors to remain exposed. Correction of defects shall be made before application of floor hardening compounds.
  5. Re-inspection: All areas requiring corrective Work will be measured in a timely manner by Owner's testing and inspection agency after completion of corrective Work. Report of measurements will be made to Contractor within 24 hours of completion of inspection.
  6. Cost of Re-inspection: Costs of inspection of corrective Work shall be paid by Contractor. Owner will deduct such costs from Contractor's next Application for Payment. If re-inspection of corrective Work occurs after 2 working days following completion of final troweling operation at final floor segment, costs of inspection of corrective Work shall include all costs for maintaining Owner's testing and inspection agency on site.
  7. Certification of Tolerance Compliance: Owner's testing and inspection agency will provide final report certifying tolerances within 10 working days of completion of concrete floors, including any corrective Work.

### 3.15 DEFECTIVE CONCRETE

- A. Defective Concrete: The following concrete will be deemed to be defective, and shall be removed promptly from the job site.
  1. Concrete which is not formed as indicated, is not true to intended alignment, is not plumb or level where so intended, is not true to intended grades and levels;
  2. Has voids or honeycomb that have been cut, resurfaced, or filled, unless with the approval of the Architect;
  3. Has sawdust, shavings, wood, or embedded debris;
  4. Does not conform fully to provisions of the Contract Documents.
- B. Repairs and Replacements:
  1. Where defective concrete is found after removal of the forms, cut out the defective concrete, if necessary, and make the surfaces match adjacent surfaces.
  2. Work uneven surfaces and angles of concrete to a surface matching adjacent concrete surfaces.



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**3.16 PROTECTION:**

- A. Protection: Protect concrete from marring and damage due to weather and construction activities.
  - 1. Protective measures shall include providing temporary coverings, as specified in Section 01 50 00 - Construction Facilities and Temporary Controls, and prohibiting all non-essential construction activities, including cleaning and maintenance of construction equipment.
  - 2. In particular, protect concrete floor slabs from oil, paint and other products which might penetrate and degrade concrete surface

**3.17 FLOOR AND SLAB CURING AND FINISHING SCHEDULE:**

<u>Location</u>	<u>Finishing</u>	<u>Curing and Sealing</u>
Interior office area floor slabs-on-grade.	Smooth trowel finish, FF35/FL25.	Moist cure only; do not use curing compound. Apply floor sealer / hardener [before moist cure as specified in Section 03360] [after curing is completed and floor cleaned.] Re-apply, after cleaning, in preparation for Substantial Completion review.
Exterior slabs, pedestrian traffic, exposed concrete finish.	Smooth trowel finish, FF25/FL20, with medium broom texture, sloped to drain.	Apply curing and sealing compound or moist cure, followed by cleaning and application of sealing compound.

**END OF SECTION**

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**SECTION 033511  
CONCRETE FLOOR FINISHES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Surface treatments for concrete floors and slabs.

**1.02 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the work with concrete floor placement and concrete floor curing.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- C. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

**1.05 FIELD CONDITIONS**

- A. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.
- B. Do not finish floors until interior heating system is operational.
- C. Maintain ambient temperature of 50 degrees F minimum.

**PART 2 PRODUCTS**

**2.01 COATINGS**

- A. Concrete Floor Topping with Aggregate: Pre-mixed blend of Portland cement, hardeners and emery/corundum.
  - 1. Product:
    - a. Ardex.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

**3.02 GENERAL**

- A. Apply materials in accordance with manufacturer's instructions.

**3.03 COATING APPLICATION**

- A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
- B. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by coating manufacturer.
- C. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
- D. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

**END OF SECTION**

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**SECTION 04 22 00  
CONCRETE UNIT MASONRY**

**PART 1 - GENERAL**

**1.01 SUMMARY:**

- A. Section Includes:
  - 1. Concrete block masonry.
  - 2. Grouting of masonry.
  - 3. Installing reinforcing steel bars in masonry.
- B. Related Work Specified Elsewhere:
  - 1. Furnishing and delivery of steel reinforcing for Concrete Unit Masonry - Section 03 20 00.
  - 2. Dowels in concrete for masonry - Section 03 20 00.
  - 3. Waterproofing – Section 07 10 00.

**1.02 REFERENCES, CODES AND STANDARDS:** The following references, codes and standards are hereby made a part of this Section shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings. Latest adopted edition of references and codes shall apply. Nothing contained herein shall be construed as permitting work that is contrary to code requirements.

- 1. American Concrete Institute “Details and Detailing of Concrete Reinforcement” – ACI 315
- 2. American Concrete Institute “Building Code Requirements for Masonry Structures” – TMS402/ACI 530/ASCE 5
- 3. American Concrete Institute “Specification for Masonry Structures” – TMS602/ACI 530.1/ASCE 6
- 4. International Building Code with State of California Amendments (CBC)

**1.03 SUBMITTALS:**

- A. Allow for a minimum of two weeks for review of submittals.
- B. Samples: Submit the following:
  - 1. Two (2) Concrete Masonry Unit samples, for initial selection purposes, in small-scale form showing full extent of colors and textures available for each different exposed masonry unit required.
  - 2. Samples of cured dry mortar showing finish color.
  - 3. Cured sealant colors for control joints.
  - 4. Control joint filler, 12" pieces of each size and type.
- C. Sample Panels: Prepare as many of following Sample panels at the site as are required for approval. Conform installed masonry to the approved panels. Approved panels may be a part of the permanent construction if so approved and conforming to all other requirements indicated and specified.
- D. Mix Designs: Submit for mortar and grout, including product data for any/all admixtures.
- E. Shop Drawings: submit reinforcing, detailing fabrication, bending, and placement of unit masonry reinforcing bars. Comply with ACI 315 - Details and Detailing of Concrete Reinforcing showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of masonry reinforcement.

**1.04 PROJECT CONDITIONS:**

- A. Protection of Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day’s work. Cover partially completed masonry when construction is not in progress. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

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- C. Stain prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Remove immediately any grout, mortar, and soil that comes in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of windows and door frames, as well as similar products with painted and integral finishes from mortar droppings.
- D. Cold-Weather Construction: Comply with the following when ambient temperature falls below 40°F (4.4°C).
  - 1. General: Remove masonry damaged by freezing conditions. Do not lay masonry units having temperature below 20°F (-6.7°C). Remove visible ice on masonry units before the unit is laid.
  - 2. Specific requirements for various temperature ranges are as follows:
    - a. Aggregates and mixing water shall be heated to produce mortar and grout temperatures between 40°F (4.4°C) and 120°F (48.9°C) at the time of mixing.
    - b. Maintain mortar temperature on mortar boards above freezing until used on masonry.
    - c. When ambient temperature is between 20°F (-6.7°C) and 25°F (-3.9°C), provide heat sources on both sides of walls under construction and install wind breaks when wind velocity exceeds 15 miles per hour.
    - d. When ambient temperature is below 20°F (-6.7°C), provide enclosures and heat sources to maintain the temperatures above 32°F (0°C) within the enclosure.
  - 3. Protection: Protect completed masonry in the following manner:
    - a. When mean daily temperature is between 40°F (4.4°C) and 32°F (0°C), protect completed masonry from rain or snow by covering with weather-resistive membrane for 24 hours after construction.
    - b. When mean daily temperature is between 32°F (0°C) and 25°F (-3.9°C), completely cover completed masonry with weather-resistive membrane for 24 hours after construction.
    - c. When mean daily temperature is between 25°F (-3.9°C) and 20°F (-6.7°C), completely cover completed masonry with insulating blankets or equal protection for 24 hours after construction.
    - d. When mean daily temperature is between 20°F (-6.7°C), maintain masonry temperature above 32°F (0°C) for 24 hours after construction by enclosure with supplementary heat, by electric heating blankets, by infrared heat lamps, or by other acceptable methods.
- E. Hot-Weather Construction: Protect masonry construction from direct exposure to wind and sun when erected in ambient temperature of 90°F (32°C) or greater in the shade, with a relative humidity less than 50%.
  - 1. Do not spread mortar beds more than 4 feet ahead of masonry. Set masonry units within one minute of spreading mortar. Dampen, but do not saturate masonry units immediately before installation.
  - 2. Mortar can be retempered with cool water only once to maintain consistency.
  - 3. Protection: When the mean daily temperature exceeds 100°F (38°C) or exceeds 90°F (32°C) with a wind velocity greater than 8 mph, fog spray all newly constructed masonry until damp, at least three times a day until the masonry is three days old.

**1.05 DELIVERY, STORAGE, AND HANDLING:**

- A. Delivery: Deliver masonry materials to project in undamaged condition.
- B. Storing and Handling Concrete Masonry Units: Store and handle masonry units off the ground, under cover, and in a dry location to prevent their deterioration or damage due to

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moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not place until units are in an air-dried condition.

- C. Storage of Cementitious Materials: Store cementitious materials off the ground, under cover, and in dry location.
- D. Storage of Aggregates: Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- E. Storage of Accessories: Store masonry accessories including metal items to prevent corrosion and accumulation of dirt and oil.

**1.06 QUALITY ASSURANCE:**

- A. Tolerances: Unit masonry shall be placed within 1/8" of dimensions noted. Reinforcement shall be placed within tolerances recommended by ACI Detailing Manual, Special Publication, SP-66, & CBC.
- B. Certificates: Submit material certificates for the following, signed by manufacturer and Contractor certifying that each material complies with requirements.
  - 1. Cement: Each different cement product required for mortar and grout including name of manufacturer, brand, type, and weight slips at time of delivery.
  - 2. Reinforcing bars: Each material and grade indicated for reinforcing bars
- C. Preconstruction Testing: Owner will employ and pay a qualified independent testing and inspection agency to perform the following preconstruction testing indicated as well as other inspection and testing services required by referenced unit masonry standard or indicated herein for source and field quality control:
  - 1. Testing Frequency: Tests and evaluations shall be performed during construction for each 5,000 sq. ft. of wall area.
  - 2. Concrete masonry unit tests: For each different concrete masonry unit indicated, units will be tested for strength, absorption, and moisture content in accordance with ASTM C140.
  - 3. Prism tests: For each type of wall construction indicated, masonry prisms will be tested in accordance with ASTM C1314.
  - 4. Grout compressive strength: Tests in accordance with ASTM C1019.

**PART 2 - PRODUCTS**

**2.01 BASIC MATERIALS:**

- A. Portland cement: ASTM C150, Type I or II, low alkali; mortar cement or plastic cement not permitted. Use one brand.
- B. Hydrated lime: ASTM C207, Type S.
- C. Mortar: ASTM 270.
- D. Mortar sand: ASTM C144, minimum 4% passing No. 100 sieve, uniformly graded fine to coarse.
- E. Grout: ASTM C476.
- F. Mortar admix: None without prior approval of Architect and Structural Engineer.
- G. Grout admix: Sika Chemical Corp. GA Grout Aid, or approved similar, type as required.
- H. Color pigment: Pure ground mineral oxides, non-fading, alkali and lime proof, factory packaged, not more than 3 pounds per sack of cement.
- I. Water: From domestic potable source.
- J. Control joint filler: Dur-O-Wal "Rapid Control Joint", wide flange unless regular flange is shown, approved sizes.

**2.02 CONCRETE MASONRY UNITS:**

- A. General: Concrete Masonry Units shall conform to ASTM C90, Grade N, standard precision type normal weight units, steam-cured or yard air cured for 28 days, meeting

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Quality Control Standards of Concrete Masonry Association, natural cement color smooth faced units unless otherwise indicated or specified. Include matching jamb, lintel, control joint, bond beam, wall cap, and other special shape, type, or size units as required.

- B. Colored Concrete Block: Same as above except integrally colored, color as selected from tan or buff range of colors.
- C. Split-Face Concrete Block: Same as above, integrally colored of the color as selected from tan or buff range of colors, with approved split texture on all exposed faces and ends.
- D. Scored-Face Concrete Block: Same as above for colored concrete block, of color as selected from full range of manufacturer's standard colors, scorings of sizes and spacing to match file sample. Include matching end scored units as required. Provide units with split texture on raised block surfaces between scores.
- E. Glazed Concrete Block: Same as above, with factory applied permanent glazed coating on block. Glazed coating shall meet the test requirements of ASTM C744. Color of glazed coating shall be as selected from manufacturer's standard colors. Glazed concrete blocks shall be "Spectra'Glaze II", manufactured by Burns & Russell, or equal.

**2.03 MORTAR AND GROUT PROPORTIONS AND MIXING:**

- A. Strengths:
  - 1. For 2,000 psi concrete masonry assemblies:  
Minimum compressive strength of concrete masonry units shall be 1,900 psi or greater, Mortar shall be Type M or S, Minimum compressive strength of Grout shall be 2,000 psi or greater at 28 days.
  - 2. For 2,500 psi concrete masonry assemblies:  
Minimum compressive strength of concrete masonry units shall be 3,750 psi or greater, Mortar shall be Type M, Minimum compressive strength of Grout shall be 3,000 psi or greater at 28 days.
- B. Proportions: Accurately measure all mortar and grout by the volume method using calibrated containers. Shovel measurements are not acceptable.
  - 1. Mortar: Mortar for use in masonry construction shall conform to ASTM C 270 and CBC Section 2103A.2.
  - 2. Grout: Grout for use in masonry construction shall conform to ASTM C 476 and CBC Section 2103A.3.
  - 3. Colored Mortar: Same as for mortar with added color pigment to produce cured dry color matching concrete unit color and the approved Sample.
- C. Mixing: Place half of the required water and sand in an operating machine mixer; then add portland cement, remainder of sand and water, and then hydrated lime. Machine mix not less than 5 minutes after all ingredients are charged.
- D. Retempering: Retemper mortar within one hour after leaving the mixer and maintain high plasticity. Add water in a basin formed in the mortar and rework mortar into water. Discard all mortar that is not used within one hour or that has begun to initially set.

**2.04 MORTAR AND GROUT PROPORTIONS AND MIXING:**

- A. Concrete Masonry Unit Tests: For each type, class, and grade of concrete masonry unit indicated, units will be tested by qualified independent testing laboratory for strength, absorption, and moisture content in accordance with ASTM C90.

**PART 3 - EXECUTION**

**3.01 INSTALLATION OF CONCRETE BLOCK MASONRY:**

- A. General: Lay out masonry units in advance to minimize cutting of units and use of odd joint sizes or bond.
  - 1. Construct all masonry in accordance with Code and Concrete Masonry Association standards for reinforced masonry.

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2. Place and embed in masonry anchors, bolts, reglets, sleeves, conduits, and all other items furnished under other Sections, fully grouted in place. Work out details and be responsible for size, position, and arrangement of embedded items and necessary openings. Unless shown in the approved construction documents, embedment of electrical conduits and plumbing running horizontally or vertically in the completed wall will not be allowed without prior notification to the Architect and Structural Engineer of Record. Embedded items shall not displace wall reinforcement.
  3. Cut units by machine saw.
  4. Install only clean uncracked units.
  5. Bracing of Masonry: The Contractor shall provide and install bracing to assure stability of the masonry during construction. The Contractor may hire an Engineer licensed in the State of California to design the bracing.
- B. Setting: Install masonry to preserve unobstructed vertical continuity of block cells. Embed face shells and cross webs in mortar. Fill header or end joints solid with mortar to a depth from face of wall or unit not less than the thickness of the longitudinal face shells. Provide corner bond by lapping units in successive vertical courses.
- C. Cleanout Openings: Provide openings at the bottom of cells containing bar reinforcing, and at each lift or pour of grout exceeding 48" height. Remove all overhanging mortar and other obstructions or debris from the interior of block cells. Seal cleanouts with matching whole units and mortar joints.
- D. Reinforcing: Use deep-cut bond beam units at horizontal reinforcing bars. Install open end units for vertical bars unless otherwise shown.
- E. Grouting:
1. Where the following conditions are met, place grout in lifts not exceeding 12.67 ft (3.86 m):
    - i. The masonry has cured for at least 4 hours.
    - ii. The grout slump is maintained between 10 and 11 in.
    - iii. No intermediate reinforced bond beams are placed between the top and bottom of the pour height.
 Otherwise, place grout in lifts not exceeding 5 feet, waiting a minimum of 1-hour between lifts.
  2. Fill all cells containing reinforcement with grout except where solid-grouting of all cells is shown.
  3. Prior to grouting, grout space shall be cleaned so that all spaces to be filled with grout do not contain mortar drippings, debris, loose aggregates, and any material deleterious to masonry grout. Mortar projections in the grout space shall not exceed 1/4 in.
  4. Consolidate grout by internal vibration, then reconsolidate about 10 minutes later or before plasticity is lost. Grout pours 12" or less in height may be consolidated by puddling.
  5. Form horizontal construction joints by stopping the grout pour 1-1/2" below the top of masonry units.
  6. Grouting of any section of wall shall be completed in one day with no interruption greater than one hour.
  7. Cleanouts: Provide cleanouts in the bottom course of masonry for each grout pour, when the grout pour height exceeds 5 feet (1.5 m). Provide adjacent to each vertical bar. Construct cleanouts with an opening of sufficient size to permit removal of debris. Minimum opening dimension shall be 3 inches (76 mm). Cleanouts shall be sealed after inspection and before grouting.
  8. Place grout within 1 1/2 hour from introducing water in the mixture and prior to initial set.
- F. Bond and Joints: Lay units with 1/2-unit running bond, vertical joints in alternate courses aligned and plumb. Make joints uniformly 3/8" size, concealed joints struck flush.

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Compact and dense concave tool exposed joints with 1-1/2" diameter plastic or similar non-staining tool.

- G. Weep Holes: Provide 1/4" diameter weep holes at bottom of ungrouted cells of exterior walls, or provide weep holes at maximum 32" centers with drain slots under webs of intervening units.

**3.02 CONSTRUCTION TOLERANCES:**

- A. Dimension of Elements
1. In cross section or elevation -1/4 in, +1/2 in. (-6.35 mm, + 12.7 mm)
  2. Mortar joint thickness
    - bed..... +1/8 in. (+ 3.18 mm)
    - head..... -1/4 in., +3/8 in. (- 6.35 mm, + 9.53 mm)
    - collar..... -1/4 in., +3/8 in. (-6.35 mm, + 9.53 mm)

Initial bed joint shall not be less than 1/4 inch (604 mm) or more than 1 inch (24 mm).
  3. Grout space or cavity width ....-1/4 in., +3/8 in. (-6.35 mm, + 9.53 mm)
- B. Elements
1. Variation from level:
    - bed joints +1/4 in. in 10 ft. (+ 6.35 mm in 3.05 m)
    - +1/2 in. maximum (+ 12.7 mm)
    - top surface of bearing walls +1/4 in. in 10 ft. (+ 6.35 mm in 3.05 m)
    - +1/2 in. maximum (+ 12.7 mm)
  2. Variation from plumb
    - +1/4 in. in 10 ft.(+ 6.35 mm in 3.05 m)
    - +3/8 in. in 20 ft. (+ 9.53 mm in 6.1 m)
    - +1/2 in. maximum (+ 12.7 mm)
  3. True to a line
    - +1/4 in. in 10 ft. (+ 6.35 mm in 3.05 m)
    - +3/8 in. in 20 ft. (+ 9.53 mm in 6.1 m)
    - +1/2 in. maximum (+ 12.7 mm)
  4. Alignment of columns and walls (bottom versus top)
    - +1/4 in. for bearing walls (+ 6.35 mm)
    - +1/2 in. for nonbearing walls (+ 12.7 mm)
- C. Location of Elements
1. Indicated in plan
    - +1/2 in. in 20 ft. (+ 12.7 mm in 6.1 m)
    - +3/4 in. maximum (+ 19.1 mm)
  2. Indicated in elevation
    - +1/4 in. in story height (+ 6.35 mm)
    - .+3/4 in. maximum (+ 19.1 mm)

**3.03 REINFORCEMENT INSTALLATION:**

- A. Place reinforcement in accordance with the sizes, types, and locations indicated on the contract drawings. Horizontal reinforcement may be placed as the masonry work progresses.
- B. Reinforcement shall be secured against displacement prior to grouting by wire positioners or other suitable devices such as wire tying, at intervals not exceeding 36 in horizontally and 24 in vertically. Place ties within 12 in of openings and unsupported edges.
- C. Tolerances: Placement of reinforcement in walls and flexural elements shall be:
1. + 1/2 inch (13 mm) when the distance from the centerline of steel to the opposite face of masonry, d, is equal to 8 inches (203 mm) or less
  2. + 1 inch (25 mm) for d equal to 24 inches (600 mm) or less but greater than 8 inches (203 mm)



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3. + 1-1/4 inch (32 mm) for d greater than 24 inches (600 mm).
  4. + 2 inches for longitudinal location of reinforcement.
- D. Clearance between reinforcing steel and the surface of the masonry shall be not less 1/4 inch (6.4 mm) for fine grout and 1/2 inch (12.7 mm) for coarse grout.
- OR for DSA/OSHPD
- E. Clearance between reinforcing steel and the surface of the masonry shall be not less than one bar diameter.
- F. Do not bend reinforcement after it is embedded in grout or mortar, unless directed by the Structural Engineer.
- G. Horizontal Joint Reinforcement: Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch (15.9 mm) on exterior side of walls, 1/2 inch (12.7 mm) elsewhere. Lap reinforcing a minimum of 6 inches (152 mm).
1. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated for structural considerations.
  2. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

**3.04 WALL CONTROL JOINTS:**

- A. Provide for walls where shown, control joint filler placed for full height of each joint. Caulk exterior face of joints according to Section 07 92 00.

**3.05 PARGING:**

- A. Parge walls wherever required to assure smooth surfaces to receive waterproofing.
- B. Clean wall surfaces thoroughly. Apply Larson Products Co. Weldcrete bonding agent to surfaces of wall in accordance with manufacturer's instructions.
- C. Apply parge coat of Type S mortar, conforming to Title 24, Table 2103.8(1) (1 part Portland cement, 1/4 to 1/2 part hydrated lime, 2-1/4 to 3 parts fine aggregate) with Laticrete latex admix added per admix manufacturer's directions. Apply in 2 uniform coats to a total thickness of 3/4 inch. Scarify first parging coat to ensure full bond to subsequent coat.
- D. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom. Damp cure parging for at least 24 hours and protect until cured. Provide nailers if required for attachment of membrane.

**3.06 CEMENT WASH ON WALL TOPS:**

- A. Use mortar with matching masonry joints. Trowel dense and smooth with clean edges, sloped as shown or directed, and cross score using an approved tool at nominal 32" centers. As soon as hardened, cover with sealed plastic sheeting and keep moist for at least 10 days after placing.

**3.07 CURING:**

- A. Keep newly constructed masonry damp for 3 days with regulated fog spray of water sufficient only to moisten faces of masonry but not in an amount as to cause water to flow down over masonry. Do not saturate masonry with water for curing or any other purposes and protect from rain or flooding during curing period.

**3.08 CLEANING:**

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- A. Clean mortar and grout off exposed surfaces immediately and as the Work progresses. Acceptably repair imperfect joints, holes, defaced units, chipped edges or corners, and all other defects, or replace the defective units as required for approval. Mortar or grout staining on exposed masonry surfaces is subject to sandblast cleaning of the entire surface involved to obtain clean uniform approved appearance, as directed and at no additional contract cost.

**3.09 FIELD QUALITY CONTROL:**

- A. Testing: Testing Laboratory shall test mortar and grout to extent shown, directed, or required by Code.
- B. Continuous Inspection: Required if indicated, and for high lift grouting operations.

**END OF SECTION**

**SECTION 05 12 00**  
**STRUCTURAL STEEL FRAMING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Structural steel framing.
  - 2. Steel pipe and tube framing.
  - 3. Shop priming and field touch-up to extent specified.
- B. Related Work Specified Elsewhere:
  - 1. Setting of anchor bolts and inserts in concrete - Section 03 20 00.
  - 2. Reinforcing steel - Section 03 20 00.
  - 3. Fireproofing for structural steel 07 81 00.
  - 4. Field painting except as specified herein - Section 09 91 00.
  - 5. Welded stud connectors - Section 05 17 00.
  - 6. Welding - Section 05 12 10.

**1.02 REFERENCES, CODES AND STANDARDS:** The following references, codes and standards are hereby made a part of this Section shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings. Latest adopted edition of references and codes adopted by the Governing Agency shall apply. Nothing contained herein shall be construed as permitting work that is contrary to code requirements.

- A. International Building Code (IBC) State of California Amendments (CBC).
- B. AISC Standards - Code of Standard Practice for Steel Buildings and Bridges (AISC 303); Specification for Structural Steel Buildings (AISC 360); and Steel Construction Manual; Seismic Provisions (AISC 341).
- C. AWS Standards - AWS D1.1, Structural Welding Code (AWS)
- D. Structural Joint Reference Specification - The Specifications for Structural Joints Using High Strength Bolts established by the Research Council On Riveted and Bolted Structural Joints of the Engineering Foundation, hereinafter referred to as "Ref Spec".
- E. Steel Structures Painting Council (SSPC): Steel Structures Painting Manual, Volume 2, Systems and Specifications.

**1.03 SUBMITTALS**

- A. Allow a minimum of two weeks for review of submittals.
- B. Comply with all pertinent provisions of Section 01 33 00.
- C. Product Data: Submit copies of producer's or manufacturer's data and installation instructions for the following products. Include laboratory test reports and other data required to show compliance with these specifications:
  - 1. Structural steel, including certified copies of mill test reports covering chemical and physical properties.
  - 2. Unfinished bolts and nuts.
  - 3. High strength bolts, including nuts and washers.
- D. Shop Drawings: Submit shop drawing covering all structural steel including welding, accessories, and fastenings. Fully detail minor connections and fastenings not shown or specified to meet required conditions. Include detailed sequence plan for shop and field welding that minimizes locked-in stresses and distortion.

- E. Weld Specification Procedures (WPS): Submit all WPS in writing (both prequalified and qualify by test) in accordance with AWS D1.1. Welding shall not proceed until WPS have been reviewed and approved by the Architect/Engineer of Record. Refer to specification Section 05 12 10 for information regarding weld specification procedures.
- F. Manufacturer's Mill Certificates: Submit mill certificates certifying that products meet or exceed specified requirements.
- G. Mill Test Reports: Submit Manufacturer's Certificates, indicating structural yield and tensile strength and destructive and non-destructive test analysis.
- H. Charpy-V-Notch (CVN) Impact Tests: Submit certified copies of Charpy-V-Notch impact tests by the manufacturer for applicable steel members and components.
- I. Test Reports: Submit reports of test conducted on shop and field welded and bolted connections, include data on type of tests conducted and test results.

**1.04 QUALITY ASSURANCE**

- A. Qualifications of Fabricator: Fabricate structural steel in shop of a licensed fabricator, AISC certified or approved similar certification, in the same category of the scope of this project.
- B. Requirements of Regulatory Agencies: Work of this Section shall conform to Title 8 CCR and to Subparagraph 1.02.A above.
- C. Source Quality Control:
  - 1. Identified Structural Steel: Tests are waived for steel identified by heat number, accompanied by mill analyses and mill test reports, and properly tagged with an Identification Certificate so as to be readily identified for conformance with applicable ASTM.
  - 2. Unidentified Structural Steel: Steel not identified and certified as specified above shall be tested according to following requirements. Structural steel fabricator shall cut samples under direction of the Special Inspector and Testing Laboratory shall machine or otherwise prepare the specimens and perform testing of each 5 tons or fraction thereof for each size of unidentified steel except, in the case of random pieces or of steel having Fy greater than 36 ksi, testing of each piece is required. Tests required are:
    - a. For pipe, one tension and elongation test and one flattening test for each size.
    - b. For all other steel, one tension and elongation test and one bend test for each size.
    - c. Contractor shall reimburse to Owner all costs paid by Owner for testing unidentified steel.
  - 3. High Strength Bolts; Nuts, and Washers: Furnish certified copy of manufacturer's test reports stating that high strength bolts nuts and washer, the requirements of their respective ASTM specifications. Materials shall also meet AISC 360, section A33 requirements.
  - 4. Testing of End-Welded Studs: As specified in Section 05 17 00.
- D. Erection and Bracing Plan and Procedure: Refer to Section 1709A, Title 8, CCR, and Building Code. Employ and pay a California registered civil engineer to prepare an erection and bracing plan and erection procedure for structural steel including columns, beams, and girders, who shall be solely responsible for its compliance. Follow the plan and procedure exactly. Keep a copy at the job site as required by California Division of Industrial Safety. File two copies of stamped erection and bracing plan and procedure for record purposes only, not for review or approval.

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- E. Comply with all pertinent provisions of Section 01 40 00 – Contractor Quality Control Program.

**1.05 PRODUCT DELIVERY AND HANDLING**

- A. Comply with all pertinent provisions of Section 01 60 00.
- B. Delivery and Handling: Protect all materials from damage during shipping, handling and storage on the site. Steel showing dents, creases, deformations, weathering, or other defects is not acceptable.
- C. Welding Electrodes: Deliver to the site in unbroken packages bearing the manufacturer's name and label identifying the contents.

**1.06 PROJECT SITE CONDITIONS**

- A. Site Measurements: Take field measurements as required. Report any major discrepancy between Drawings and field dimensions.
- B. Protection of Floors: Use caution to protect floor slab and adjacent Work from damage. Do not overload floors. Use rubber tired equipment to handle and move steel. Do not place steel members directly on floor; use pads of timber or like material for cushioning.
- C. Temporary Flooring: Provide necessary temporary planking, scaffolding, and flooring for erection of structural steel or support of erection machinery. Conform use of temporary floors or steel decking to Code.

**PART 2 - PRODUCTS**

**2.01 BASIC MATERIALS:** Furnish materials conforming to the following

- A. Steel shapes: ASTM A36 and A992, as noted on drawings.
- B. Steel plates: ASTM A36 and A572-GR50 as noted on drawings.
- C. Steel tubing: ASTM A500, Grade C, Fy = 50 ksi.
- D. Steel pipe: ASTM A53 standard weight for general use; ASTM A53 Grade B where used for structural purposes.
- E. Bolts and nuts: ASTM A307.
- F. High-strength bolts, nuts, and washers: ASTM A325/F1852 or ASTM A490/F2280 as indicated for the bolts, ASTM A563 Grade C for nuts, and ASTM F436 for carburized washers. ASTM F959 for load indicating washers. All high-strength bolts shall have a suitable identifying mark placed on top of bolt head at the factory. Refer to drawings for bolt specification requirements.
- G. Anchor Rods: ASTM F1554, A307 or A449 or as specified per contract documents.
- H. Primer: Use types acceptable to governing air quality management officials.
- I. For above-grade locations: Lead free metal primer, Tnemec V-10 or Rust-Oleum X-60 or approved equal.
- J. For below grade applications: Coal-tar epoxy coating, two coats, 5 mils per coat. Perma Bar, as manufactured by Karlee Co., Burbank, CA, or approved equal. Touch-up on job site with Perma-Bar coal-tar epoxy, match finish coat thickness.
- K. Non-shrink grout: Master Builders "Embeco 636", or equal, non-gas-forming, free of oxidizing catalysts and inorganic accelerators, performance and characteristics when mixed to a fluid consistency meeting ASTM C1107, CRD-C-79 and CRD-C-621, non-staining type in exposed areas.
- L. Galvanizing: Hot dipped galvanization shall conform to ASTM A-123. Touch up infield with zinc rich cold applied material; "Galvaloy" or approved equal.

## 2.02 GENERAL FABRICATION REQUIREMENTS

- A. Fabricate structural steel in accordance with the approved submittals, reference standards as applicable, and requirements herein. Fabricate and form the work to meet actual installation conditions verified at the site.
- B. **Cleaning and Straightening:** Thoroughly wire brush material, clean off loose mill scale and rust, and straighten by methods that will not injure the steel prior to fabrication. Remove twists or bends after punching or working component parts of a member before the parts are assembled. Produce finished members free from twists, bends, and open joints when erected.
- C. **Contact:** Pin component parts of built-up members and maintain in close contact using clamps or temporary bolting during welding operations. Accurately mill compression bearing surfaces of joints depending on contact bearings or saw cut square to axis, or as detailed. Cut other joints straight and true.
- D. **Joining:** Provide members of the sizes, weights, shapes, and arrangements indicated, closely fitted and finished true to line and in precise position as necessary to allow proper joining of parts in the field. Drifting to enlarge unfair holes is not allowed without prior approval.
- E. **Drilling, Punching, and Reaming:** Hole burning to make or enlarge previous holes is allowed only with prior approval. Prepare required holes in structural steel members, as shown on the Contract Documents, for attachment or passage of Work of other trades. Precisely locate finished holes to ensure passage of all bolts through steel assemblies without drifting. Enlarge holes only by reaming. Poor matching of holes is cause for rejection.
- F. **Holes For Anchor Bolts:** Punch and drill or ream holes in base and bearing plates. Do not make or enlarge the holes by burning except for grouting holes in column bases without prior approval by the Architect.
- G. **Gas Cutting:** Make all gas cuts with a smooth regular contour. Make radius of reentrant gas cuts as large as possible.
- H. **Base Plates:** Press or mill steel column base plates 4" thick or less for straight contact bearing between plate and column.

## 2.03 CONNECTIONS

- A. Make connections with bolts as noted on the Structural Drawings.
- B. **High-Strength Steel Bolting:** For joints connected by high strength steel bolts, hardened washers, and nuts tightened to high tension, conform materials, method of installation and tension control, and wrenches to Reference Standards and AISC 360. Install all high-strength bolts under inspection required by AISC 360.
  - 1. Connections shall be the "bearing bolt type" (A325-N) unless noted to be "friction type" or "slip-critical" (A325-SC and A490-SC). Refer to drawings.
  - 2. Bolt lengths shall be as required to achieve the design condition with the bolt head at least flush with the face of the nut.
  - 3. Tightening of nuts shall be done with properly calibrated wrenches or by the turn-of-the-nut method for A325-SC and A490-SC bolts. Tightening of the nuts for A325-N bolts to snug tightness shall be to Ref. Spec. Allowable bolt stresses shall conform to AISC 360 and referenced standards.
  - 4. Check calibrated wrenches individually for accuracy not less than once daily for actual conditions of application.
  - 5. Clean all contact surfaces of bolted parts and threads free of scale, slag, burrs, pits, dirt, paint, and other foreign material or defects which would prevent solid seating of connected parts.

6. Install hardened washers per AISC 360 and referenced standards.
  7. Tighten bolts systematically from most rigid part of connection to the free edges.
  8. Retighten first installed bolts that may have loosened by tightening of subsequent bolts so all bolts are tightened to correct tension.
  9. Mark fully tightened bolts with identifying symbol.
  10. The Inspection and Test Lab shall torque test 25% of the bolts in connections designated with A325-SC or A490-SC Bolts. This requirement is waived when direct tension indicators, load indicating washers or tension control bolts are used.
  11. Bolt lengths shall equal the grip plus 1-1/4-inch.
- C. Welded Stud Connectors: Conform to requirements of Section 05 17 00.
- D. Load Indicator Washers: May be used for the field installation of the high-strength bolts. Load indicator washers may not be substituted for any required washer, but may be used in conjunction with the required washers. Conform tightening to Paragraph 5e of the Reference Spec listed under Section 1.2. After sufficient bolts in a joint are snugged to bring the members into close contact, tightening shall progress from the most rigid part to the free edges until the load indicators on all bolts are closed to the required gap of 0.015" under bolt heads or 0.010" under the nuts. Feeler gauge verification may be dropped to 50% of installed bolts when utilizing "Squirter DTIs" supplied by Applied Bolting Technologies. Conform to ASTM F959, A325 and A490. Do not completely close the gap to prevent over-tightening and damage to the bolts.
- E. Tension Set or Load Indicator Bolts, Nuts, and Washers: May be used for field installation of the high-strength bolts. In multi-bolt joints, the nuts shall be tightened in stages (a little at a time) without breaking the spline in any of them until the final stage, to minimize slackening of the installed bolts.

## 2.04 WELDING

- A. Shop and field welding shall conform to the requirements noted below and the provisions in section 05 12 10 of the specifications. Where the requirements differ between this section and section 05 12 10 the more stringent requirement shall govern.
- B. Conform to CBC Chapters 17A and 22A, AWS D1.1 and AISC 341 as modified by referenced AISC Standards, and as indicated or noted on Drawings. Employ welding operators qualified in accordance with AWS D1.1, as applicable, who are thoroughly trained and experienced in arc welding and that produce uniformly reliable groove and fillet welds in flat, vertical, and overhead positions, and make neat and consistent welds. Weld all structural steel joints by shielded electric-arc method unless otherwise shown, specified, or approved. Conform welding in both shop and field, including the prequalification of welds and welder qualifications, to AWS D1.1.
- C. Storage and Care of Electrodes: Coatings of low-hydrogen type electrodes shall be thoroughly dry as used. Conform to AWS D1.1; use electrodes as taken from hermetically sealed packages within time limit specified therein after package is opened. Electrodes not used within allowable time period and electrodes that have been exposed more than one hour to air having a relative humidity of 75% or greater, or as required by the manufacturer, shall be dried according to AWS D1.1 before they are used, or shall be reconditioned according to electrode manufacturer's recommendations. Electrodes so dried or reconditioned not used within allowable time period after drying is completed shall be redried before use. Electrodes of any class that have been wet shall not be used under any conditions.
- D. Preparation: Clean steel surfaces to be welded of all paint, grease, oil, foreign matter. Clean weld each time the electrode is changed. Chip full surface of hand guided and controlled flame cut edges before welding. Surfaces prepared with automatic or mechanically guided and controlled equipment need not be ground or chipped before welding.

- E. Weld Finishing: Grind exposed welds subject to contact to smooth surfaces free of holes, slag, or other defects, flush with the adjoining surfaces. No finish treatment is required for permanently concealed welds and other exposed welds.
- F. Procedures: During assembling and welding, hold components of a built-up member with adequate clamps or other means to keep parts straight and in close contact. Do no welding in wind with speeds above the manufacturer's recommendation until adequate protective screening is set up. Cut out defective welds or parts of welds by grinding or with a chisel or air arc and replace.
- G. Weld Characteristics: Conform to AWS D1.1.
- H. Refer to welding specifications 05 12 10 for procedures not outlined.

**2.05 SHOP PRIMING**

- A. Clean surfaces according to AISC Specifications. Apply one shop coat of specified metal primer to minimum 1.0 mil dry film thickness. Work primer into joints. Do not prime the following:
  - 1. Steel surfaces embedded in concrete or masonry with the exception of those steel surfaces that support anchored brick veneer.
  - 2. Permanently concealed structural steel surfaces.
  - 3. Contact surfaces of high-strength bolted connections.
  - 4. Surfaces to receive directly adhered fireproofing.

**2.06 GALVANIZING**

- A. Galvanize all exposed steel by the hot-dipped process after fabricated. Do not galvanize area requiring field welding.

**2.07 SOURCE QUALITY CONTROL:**

- A. Source Quality Control, General: Materials and fabrication procedures shall be subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency, as specified in Section 01 40 00 - Quality Control.
  - 1. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.
  - 2. Promptly remove and replace materials or fabricated components that do not comply.
- B. Design of Members and Connections: Details shown on the Drawings are typical. Similar details shall apply to similar conditions, unless otherwise indicated.
  - 1. Verify dimensions at Project site whenever possible without causing delay in the Work.
  - 2. Promptly notify Architect (Structural Engineer) whenever design of members and connections for any portion of structure are not clearly indicated.
- C. Shop-Bolted Connections: Inspect or test in accordance with AISC specifications. Verify that gaps of installed Direct Tension Indicators are less than gaps specified in ASTM F959, Table 2.
- D. Shop Welding: Inspect and test during fabrication of structural steel assemblies, as follows:
  - 1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
  - 2. Perform visual inspection of all welds.
  - 3. Perform tests of welds and conduct inspections using procedures listed below, as required by authorities having jurisdiction.
    - a. Liquid Penetrant Inspection: ASTM E165.



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- b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration not acceptable.
- c. Radiographic Inspection: ASTM E94; minimum quality level "2-2T."
- d. Ultrasonic Inspection: ASTM E164.

### **PART 3 - EXECUTION**

#### **3.01 ERECTION OF STRUCTURAL STEEL**

- A. Brace and secure structural steel members until permanent connections are completed. Provide accessories and fasteners to secure steel in place as shown and required. Conform to CBC, Title 24 CCR, AISC Standards, and erection and bracing plan and procedure.
- B. Employ qualified riggers and plan erection to require minimum cutting. Erect members plumb, true to line and level, and in precise positions. Provide temporary bracing and guying to resist loads and stresses to which the structure may be subjected, including those due to erection equipment and its operation.
- C. Damaged Members: During erection, straighten or replace members which are bent, twisted, or damaged as directed. If heating is required, perform heating by methods that ensure a uniform temperature throughout the entire member. When directed, remove members damaged to an extent impairing appearance, strength, or serviceability and replace with new members at no extra cost to the Owner.
- D. Anchor Rods: Furnish and deliver anchor rods with setting drawings and templates. Verify position of bolts prior to delivery of steel; report errors or deviation for correction.
- E. Steel Columns: Set column bases in position for alignment, plumb and straight, supported on adjustable bolt supports or shims until grout has set. Set center of base true to column center within AISC tolerances. Maintain bases at position and level during grouting.
- F. Connections: Hold steel in correct position during welding and bolting, and provide for dead loads, wind, and all erection stresses. Do no welding or final bolting until members have been aligned and plumbed.
  - 1. Field Welding: Conform to requirements for shop fabrication.
  - 2. Common Bolts: Tighten and upset bolt threads to preclude loosening, or use approved self-locking nuts.
  - 3. High-Strength Bolting: Tighten according to Code, AISC Standards and the Reference Standard.
  - 4. Welded Stud Connectors - Site Installed: Field install welded stud connectors in accordance with manufacturer's recommendations.
- G. Tolerances: Erect members to the tolerances conforming to referenced AISC Standards and CBC.

#### **3.02 FIELD TOUCH-UP PAINTING**

- A. After structural steel erection and connections are completed and approved, clean all connections to be painted and damage to shop painted surfaces, and apply a field touch-up coat of same metal primer used for shop coat.
- B. After structural steel erection and connections are completed and approved, clean all connections to be galvanized and damaged galvanized areas, and apply a field touch-up coat of zinc rich galvanizing coating.

#### **3.03 FIELD QUALITY CONTROL**

- A. Comply with all pertinent provisions of Section 01 40 00.

- B. All welders shall be qualified for each process and position per the latest edition of AWS D1.1 - Performance Qualifications. The welder's qualification shall be considered as remaining in effect indefinitely unless the welder is not engaged in a given process of welding for which the welder is qualified for a period exceeding six months or unless there is some specific reason to question a welder's ability.
- C. Inspection: According to Reference Standards. Inspector shall visually inspect welds, shall be present to inspect and approve all groove and penetration welding, and shall inspect all erection including the grouting under base plates.
- D. Inspection of Shop Fabrication: Required for structural steel according to CBC Section 1705A.2. Inspection is provided by the Owner's Independent Testing Laboratory.
- E. Inspection of Shop and Field Welding: Required for all structural steel according to CBC Section 1705A.2 & 1705A.12.1. Inspection is provided by the Owner's Independent Testing Laboratory/Special Inspector.
- F. Tests of Welding: Testing Laboratory shall inspect all shop and field welding, conform to requirements of code and building department, and certify in writing, after completion of work, that welding has been performed in accordance with the drawings, specifications, and code.
- G. Inspection of High Strength Bolt Installation: Required for both shop and field installation according to AISC. Inspection is provided by the Owner's Independent Testing Laboratory/Special Inspector. Testing Laboratory shall check bolt tightness on a minimum of 10 percent of the bolts, selected at random, for each high-strength bolted joint. Inspection procedure shall conform to the reference standard.
- H. Inspection and Testing of Welded Stud Connectors: According to Section 05 17 00, including pre-production testing and production inspection and testing.
- I. Erection Inspection: Special Inspector shall inspect all erection including the grouting under base plates.
- J. Non-Destructive Welding Inspection: The Special Inspector(s) shall continuously inspect and test all welds by ultrasonic or other non-destructive tests as approved. Test procedure for ultrasonic tests shall conform to AWS D1.1 and requirements herein.
  - 1. Required Testing: Test following welds by ultrasonic testing method:
    - a. Full Penetration Groove welded connections of column to column, column to girder, girder to girder, and like connections.
    - b. Other welded connections indicated to be ultrasonically tested on Structural Drawings.
    - c. Other welds directed to be ultrasonically tested by the Architect, Structural Engineer, or Project Inspector.
  - 2. Ultrasonic Testing: An AWS Certified Welding Inspector, provided by the Owner and approved by the Engineer of Record shall operate ultrasonic testing equipment, examine welds, and maintain a record of welds examined, defects found, and disposition of each defect. Defective welds shall be repaired in accordance with AWS D1.1, and costs for retesting defective welds shall be responsibility of the Contractor. Tests shall be complete tests according to AWS D1.1.
  - 3. Rate of Testing: Test welds requiring ultrasonic testing at 100 percent. No reduction in testing rate will be permitted.
  - 4. Backing Strips: Remove backing strips whenever ultrasonic indications arising from weld roots can be interpreted as either a weld defect or a backing strip, and retest weld if no root defect is visible. If no defect is disclosed by retest and no significant amount of the base and weld metal is removed, joint needs no further repair or welding. Repair all defects disclosed. Contractor shall bear the cost of

removals and repairs where the indication is the result of a rejectable lack of fusion or inclusion. The cost of removal and retest as a result of false indications will be paid by the Owner.

5. Questionable Root Indications: Root indications that prove not to be defective welds shall not count against the welder to increase the test rate.
6. Ultrasonic Instrumentation: Calibrated by technician to evaluate the quality of welds in accordance with AWS D1.1, Sections 5 and 6.
7. Acceptance Criteria: In accordance with larger reflector criteria of AWS D1.1.

**END OF SECTION**

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**SECTION 051700  
WELDED STUD CONNECTORS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. This Section covers the technical requirements for welded stud connectors and forms a part of all other Sections which require stud connectors, anchor studs, stud shear connectors, and similar items to be provided in accordance with this Section.
- B. Related Work Specified Elsewhere:
  - 1. Structural Steel, Section 05 12 00.

**1.02 REFERENCES, CODES AND STANDARDS:** The following references, codes and standards are hereby made a part of this Section shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings. Latest adopted edition of references and codes adopted by the Governing Agency shall apply. Nothing contained herein shall be construed as permitting work that is contrary to code requirements.

- A. American Welding Society – Structural Welding Code (AWS D1.1).
- B. American Society of Testing and Materials (ASTM) Standards ASTM A108, grades C1010 through C1020.
- C. International Building Code (IBC) with the State of California Amendments (CBC).

**1.03 SUBMITTALS**

- A. Comply with all pertinent provisions of Section 01 33 00.
- B. Product Data: Submit following items for review; maintain copies of the following readily available at the site whenever welded stud connectors are being installed:
  - 1. Certified evidence stud bases are qualified in accordance with CBC.
  - 2. Stud manufacturer's installation instructions with a complete listing, by manufacturer and model, of stud welding equipment approved by stud manufacturer.
- C. Samples: Submit samples as may be requested.

**1.04 QUALITY ASSURANCE**

- A. General: Furnish studs and stud bases currently qualified in accordance with CBC, AWS D1.1, latest revision, and install in accordance with the procedures and quality control requirements of AWS D1.1, latest revision. Employ welding mechanics that are skilled and experienced in installing required studs and currently qualified in accordance with AWS D1.1, latest revision.
- B. Comply with all pertinent provisions of Section 01 45 00 – Contractor Quality Control Program.

**1.05 PRODUCT DELIVERY, HANDLING AND STORAGE**

- A. Comply with all pertinent provisions of Section 01 60 00.
- B. Protect materials from damage during shipping, handling, and storage at the site. Deliver studs to site in unbroken sealed packages bearing manufacturer's name and label identifying the contents.

## **PART 2 - PRODUCTS**

### **2.01 STUD CONNECTORS**

Standard product steel stud units intended for welding by automatically timed stud-welding equipment, furnished complete with an arc shield (ferrule) of heat-resistant ceramic or equivalent for all studs and, for studs 5/16" diameter or larger, a deoxidizing and arc stabilizing flux; no studs painted, galvanized, or cadmium plated prior to welding and all finished by cold heading, cold rolling, or machining; all of uniform quality and condition, free of injurious laps, fins, seams, cracks, twists, bends not indicated, rust, rust pits, scale, oil, or other injurious defects or substances.

- A. Stud Steel: Furnish end-welding studs manufactured of steel conforming to ASTM A29, Grade 1010 through 1020 cold-drawn steel of minimum 60,000 psi tensile strength with 20% elongation in 2".
- B. Manufacturer: Nelson Stud Welding of TRW Nelson Division, KSM Division of Omark Industries, TruWeld of Tru-Fit Products or approved equal.

## **PART 3 - EXECUTION**

### **3.01 INSPECTION**

- A. Verify that galvanizing on steel deck does not exceed the zinc coating approved for stud installation. Report in writing all conditions that prevent or interfere with the proper installation of studs including loose steel decking or improper fitting.

### **3.02 PREPARATION**

- A. Conform to AWS D1.1, approved submittals, and requirements herein.
- B. Cleaning: Clean surfaces to receive the studs of paint, scale, rust, and other injurious substances by wire brushing, peening, prick-punching, grinding, or other method as required to produce clean bare substrates.
- C. Preparation for Replacement Studs and Repairs: Repair steel surfaces as follows wherever a defective stud is removed. Make area where a stud is removed flush and smooth if the surface remains exposed in the Work. Complete repairs before installing a replacement stud on a defect area.
  - 1. Areas Subject To Tensile Stress: Make the area flush and smooth. If the base metal is pulled out by stud removal, fill pocket by shielded metal-arc welding conforming to AWS D1.1, latest revision, using low-hydrogen electrodes, and grind the weld surfaces flush.
  - 2. Areas Subject To Compression: Where any stud failures are confined to shanks or fusion zones of the studs, a new stud may be installed adjacent to the defective area in lieu of repairing defective area and installing a replacement stud, subject to approval. If metal is pulled out of base metal, fill pocket as specified above for tensile stress areas except, if the defect depth is not more than the lesser of 1/8" or 7% of base metal thickness, the defect may be faired by grinding in lieu of weld filling.

### **3.03 STUD WELDING**

- A. Conform to AWS D1.1, approved submittals, and requirements herein.
- B. Welding Equipment: Furnish automatically timed stud-welding equipment and a suitable power source, of type and manufacturer listed as approved by the stud manufacturer. Interlock the welding equipment supplying current to two or more stud-welding guns so that only one gun can operate at a time and so power source has fully recovered from making one weld before another weld is started.

- C. Installation: Do not install studs on wet surfaces, nor any studs showing defects, rust, rust pits, scale, oil, or other deleterious substance. Hold the steel decking tight to the supports prior to stud installation. Install studs promptly after cleaning and preparation. Hold welding gun in correct position and without movement until the weld metal has solidified. Break and remove arc shields after welding. Produce welded studs free from any defect or substance that interferes with intended functions.
1. Placing Locations: Singly space shear stud connectors along the beam centerline with excess double studs spaced symmetrically from each end of the beam. Place adjacent studs on centers not closer than 3" transversely and not closer than 4-1/2" longitudinally, on centers. Provide minimum distance between edges of the shear stud bases and flange edges equal to the stud diameter plus 1/8", but minimum 1-1/2" clearance wherever possible. Location accuracy of other types of studs shall permit the assembly of attachments without alterations or reaming.
  2. Stud Lengths: Stud lengths indicated or noted are minimum acceptable net lengths after welding. If reduction in length of a stud as it is welded is such that length of the stud is more than 1/16" greater than that specified by stud manufacturer, discontinue stud installation until the cause is determined and eliminated and pre-production testing is satisfactorily repeated.
  3. Defective Fillets: Any stud not showing a full 360° weld fillet after welding may be repaired by welding a 3/16" fillet weld in lieu of missing weld fillet in accordance with AWS D1.1, latest revision using low-hydrogen electrodes.

### 3.04 FIELD QUALITY CONTROL

- A. Comply with all pertinent provisions of Section 01 41 00.
- B. Inspection: Perform pre-production shop and field welded stud installation and testing under continuous inspection of a qualified welding inspector approved by the city. In addition to the verified report, welding inspector's reports shall detail the location of all defective studs with the repair or replacement action taken.
- C. Inspection Procedure: Welding equipment type and capacity shall be in accordance with manufacturer's recommendations and shall be checked and approved by the welding inspector. At beginning of each day's work, a minimum of two test studs shall be made with the equipment to be used to metal which is the same as the actual work piece. Test studs shall be subjected to 90 degree bend test by striking them with a heavy hammer; after this test, the weld section shall not exhibit any tearing out or cracking.
- D. Pre-Production Testing: The following tests are required for each welding equipment power source at start of each production period (time interval from start-up to any shutdown of any stud-welding equipment), at the start of any new welding procedure, and after any change in the welding procedure.
  1. Pre-Production Tests - Stud Shear Connectors: After cooling, test the first two studs on a member by hammer bending to a 45 degree angle. If failure occurs in the weld zone of either stud, correct the procedure, and weld and bend test two more studs on the member. If either of the second two studs fails, continue additional welding on separate materials until two consecutive studs are tested and found satisfactory. Then weld two studs to the same member, bend test, and find satisfactory before any more studs are welded to the member.
  2. Pre-Production Tests for Studs Other Than Shear Connectors: Weld two studs to separate material in the same general position (such as flat, vertical, sloping, or overhead) and of similar steel material and thickness as members to receive studs. After cooling, hammer bend the studs to a 30 degree angle. If failure occurs in any stud shank, ascertain and correct the cause before making further welds. If failure occurs in the weld zone of either stud, correct the procedure and successfully weld and test two successive studs before any studs are welded to members.

- E. Production Inspection and Testing:
  - 1. Inspection of Stud Shear Connectors: After cooling, test at least one stud on each steel member by hammer bending to a 15 degree angle, or test each stud by striking twice with a 6-pound hammer to verify that quality welds are obtained. If failure occurs either in weld zone or stud shank, follow method of correction as required herein for pre-production testing until successful installations are produced, and replace all defective studs. Test all those studs (a) not showing full 360 degree fillet weld or (b) are repaired by welding, (c) replacement studs, and (d) in which the reduction in length is less than correct by hammer bending to a 15 degree angle. For studs showing less than a 360 degree weld fillet, bend the stud in the direction opposite to missing fillet metal. Remove and replace studs that crack in the weld zone, base metal, or the shank under inspection and testing or under subsequent straightening.
- F. Straightening: Leave in a bent condition those stud shear connectors and shear transfer devices that are bent less than 15 degrees and are free of any failure provided no part of studs is within 1" of an exposed concrete surface. Perform stud bending and straightening without heating and before the completion of each day's welding operations. Obtain inspection and approval of straightened studs before covering.
- G. Load Testing: Testing Laboratory shall load test studs to the extent and by the methods directed.

**END OF SECTION**

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**SECTION 054000**  
**COLD-FORMED STRUCTURAL METAL FRAMING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Section Includes: This section covers load bearing cold-formed structural metal framing, including all design, engineering, materials, labor, equipment and services necessary for the complete fabrication, assembly, delivery, anchorage and erection of the exterior light gauge metal framing system.
- B. Related Work Specified Elsewhere:
  - 1. Light gage non-structural metal framing, furring and suspension systems - Section 09 22 16.

**1.02 REFERENCES, CODES AND STANDARDS:** The following latest edition of the references, codes and standards are hereby made a part of this Section and work shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings. Latest adopted edition of references and codes adopted by the Governing Agency shall apply. Nothing contained herein shall be construed as permitting work that is contrary to code requirements.

- A. American Iron and Steel Institute (AISI) Specification for Design of Cold-Formed Steel Structural Members.
- B. American Welding Society Standards (AWS): AWS D1.3, Structural Welding Code – Sheet Steel.
- C. American Society of Testing and Materials (ASTM) Reference Numbers:
  - 1. ASTM A1003, Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
  - 2. ASTM C955, Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.
  - 3. ASTM C1007 – Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Assemblies.
- D. International Building Code (IBC) with State of California Amendments (CBC)

**1.03 SUBMITTALS:**

- A. Calculations: For projects with prescriptive specifications for the exterior wall framing systems, provide complete calculations for conditions not detailed in the drawings indicating conformance with specified design criteria. Calculations shall be signed by a registered Civil or Structural Engineer licensed in the State of California.
- B. Shop Drawings: Submit shop drawings fully detailing all work not detailed in the drawings, including accessories, fastenings, and welding. Include connections and fastenings not indicated or specified to meet required conditions; indicate in detail in shop drawings. Shop drawings shall be signed by a registered Civil or Structural Engineer, licensed in the State of California.
- C. Product Data: Submit complete material list for all work of this section. Include ICC evaluation reports.

**1.04 QUALITY ASSURANCE:**

- A. Code: Conform all fabrications and installations to code. In case of conflict between contract documents and code, the more stringent requirements shall govern. Conform fire resistance rated construction to requirements of California State Fire Marshal.



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- B. Qualifications of Fabricator/Erector: The firm manufacturing and installing the work of this section shall have had not less than 5 years experience in work of similar nature and complexity to that required under this contract.
- C. Design Criteria: Drawings indicate general arrangement, aesthetic requirements and minimum sizes of principal members only. Contractor shall complete the design and provide wall framing of the design indicated, constructed to withstand a uniform wind load as required by the applicable codes described in Section 1.02. Use exposure category C, Importance Factor of 1.0, and a Basic Wind Speed of 102 mph per the requirements of the Code. Limit deflections to a maximum of L/240 unless the architect specifically approves a variance. Seismic loads shall be based on weights of materials and items attached to the framing, site seismic force levels and height within the building.
- D. Tolerances: Erect walls and partitions on straight lines, plumb, free of twists or other defects, and contacting a 10-foot straightedge for its entire length at any location within a 1/8" tolerance. Erect horizontal framing level within a tolerance of 1/8" in 12-feet in any direction. Erect sloped framing in true planes to same tolerance as horizontal framing

**1.05 PRODUCT DELIVERY AND HANDLING:**

- A. Delivery and Handling: Protect all materials from damage during shipping, handling and storage on the site. Studs showing deformations, weathering, or other defects are not acceptable.
- B. Welding Electrodes: Deliver to the site in unbroken packages bearing the manufacturer's name and label identifying the contents.

**1.06 PROJECT SITE CONDITIONS:**

- A. Site Measurements: Take field measurements as required. Report any major discrepancy between drawings and field dimensions.
- B. Protection of Floors: Use caution to protect floor or roof slab and adjacent work from damage.
- C. Temporary Flooring: Provide necessary temporary planking, scaffolding, and flooring for erection of load bearing metal studs as necessary. Conform use of temporary floors to code.

**PART 2 - PRODUCTS**

**2.01 MATERIAL**

- A. Light gauge metal framing: Conform to ASTM C955. Yield strength shall be 33 ksi for 20 gage (33 mils) and thinner, 50ksi for 18 gage (43 mils) and thicker. Framing shall be manufactured by Cemco, ClarkDietrich, SSMA, or approved equal.
- B. Gages and properties of studs shall be as indicated and approved on shop drawings.
- C. Mechanical anchors to concrete and masonry shall be not less than 3/8-inch in diameter threaded bolt head type. Anchor bolts to be set in concrete shall be headed type 1/2 inch diameter or more.
- D. Mechanical anchors to metal framing shall be No. 8 self tapping and self drilling wafer head screws minimum.
- E. Accessories: Special top tracks, angles, fasteners, strips of gypsum wallboard, fire safing and mineral wool as required for fire rating assembly required at each condition as specified by the Architect.
- F. Backing Plates: Galvanized sheet metal for attachment and support of products to be attached to framing.
  - 1. 16 gage (54 mils) material covering full width of stud spacing by 6-inches wide minimum with 4 - #8 screws to each stud minimum.
  - 2. 6-inch by 1-1/4 inch by 14 gage (68 mils) track with flanges cut to clear stud, folded flat and screwed to each stud with 6 - #8 screws minimum.

3. As indicated on Drawings.

**2.02 FABRICATION**

- A. The work shall be fitted, shop assembled and ready for erection.
- B. Provide cutting, tapping and drilling of metal framing for installation or attachment of work of other sections.
- C. Exposed joints shall be made where least conspicuous in final product.
- D. Provide plates and mountings for items of finish hardware to the metal framing.

**2.03 WELDING**

- A. Welding shall be in accordance with applicable Codes and the AWS Standards for fusion and gas cutting or welding.
- B. Welding shall be done on the unexposed sides to prevent pitting, discoloring, weld-halo and other surface imperfections.
- C. Welding electrodes: As permitted by AWS D1.3.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

- A. Install structural studs where indicated on drawings, spaced at 16" centers, 12" on center in plumbing walls and at walls receiving ceramic tile, unless otherwise indicated, complete with tracks and shoes. Allow for deflection of structure above. Provide doubled studs or bearing studs at jambs of all openings more than 24" wide, and at all door frames.
- B. Tracks shall be securely anchored to the supporting structure as detailed on approved shop drawings or at 24" on center, maximum. At track butt joints, abutting pieces of track shall be anchored to a common structural element, or they shall be butt-welded or spliced together.
- C. Studs shall be plumbed, aligned and attached to the flanges or webs of both upper and lower tracks with #8 screws at each flange. All studs shall have full bearing on bottom tracks. Splicing of studs will not be permitted.
- D. Jack studs or cripples shall be installed below window sills, above window and door heads, at free standing stair rails, and elsewhere to furnish support and shall be anchored to supporting members.
- E. Stud Bracing: For wall studs without sheathing attached to both flanges, cut bridging to fit between, and connected to, studs or inserted through cutouts in the web of each stud. Provide bridging as follows:

<u>Wall/Partition Height</u>	<u>Bridging</u>
Up to 8 feet	1 row at approximately 1/2 span
10 to 15 feet	2 rows at approximately 1/3 span
15 to 20 feet	3 rows at approximately 1/4 span
20 to 25 feet	4 rows at approximately 1/5 span

- F. Make provision for structure vertical movement with vertical slide clips or other method as indicated on approved submittals.
- G. Where framing is subject to vertical loads, provide uniform and level bearing support for bottom track. Provide all additional studs to resist horizontal components as required.
- H. Joists Installation: Align joists with stud framing to avoid joists bearing on unsupported stud track. Provide doubled joists over all partitions running parallel with the joists. Joists shall have at least 1-1/2 inches of bearing and shall be reinforced over bearings to prevent web crippling.

I. Joist Bracing: Provide manufacturers standard lateral bracing for joists as follows:

<u>Clear Span</u>	<u>Bridging</u>
Up to 14 feet	One row near center
14 to 20 feet	Two rows at 1/3 of span
20 to 26 feet	Three rows at 1/4 points of span
26 to 32 feet	Four rows at 1/5 points of span.

J. Install supporting members, fastenings, frames, hangers, bracing, brackets, bolts, angles and other items as required to set and connect the metal framing to the concrete or steel structural framing.

K. Backing and Blocking: Install sheet metal backing as indicated and as required to support all products attached to wall or ceiling after completion of finish surface, including toilet and bath accessories, plumbing and electrical fixtures, electrical panels, toilet partitions, casework, hardware, handrails and trim.

L. All welded connections are to be made in accordance with AWS D1.3.

**3.02 CONNECTIONS TO METAL DECKING:**

A. Provide premolded neoprene filler strips matching the flute profile for non-fire-rated walls and partitions covered on one or both sides up to metal decking.

B. The top runner track of fire-rated partitions shall be a minimum of 20 gauge (33 mils) and attached to the metal deck with approved fasteners at spacing required for fire rating, but in no case over 16" o.c. Areas above the runner shall be friction fit with mineral wool insulation as noted in Architectural drawings. Install required special tracks, angles, fasteners and strips of gypsum wallboard as required to achieve required fire resistance rating.

**3.03 CLEANING AND TOUCH-UP:**

A. Remove surplus materials. Clean and touch-up raw edges of studs cut for openings and at welded connections with anodic galvanizing repair paint. Leave decks ready to receive subsequent materials.

**3.04 FIELD QUALITY CONTROL:**

A. All cold-formed structural metal framing shall be inspected by project inspector for conformance with the drawings and details including fit-up, bracing, connections, backing plates and finishes.

B. All metal framing welding shall be approved by Inspector before being covered. Welder qualifications and welding inspection shall conform to Code.

**END OF SECTION**

**SECTION 061000**  
**ROUGH CARPENTRY**

**PART 1 - GENERAL**

**1.01 SUMMARY:**

- A. This section covers Rough Carpentry, including all materials, labor, equipment and services necessary to complete this work.
  - 1. Structural floor, wall, and roof framing.
  - 2. Built-up structural beams and columns.
  - 3. Floor, wall and roof sheathing.
  - 4. Furring for wall finishes.
  - 5. Rough hardware, fasteners, framing anchors and connectors.
  - 6. Blocking for roofing systems and related metal flashings.
  - 7. Preservative treatment.
  - 8. Concealed wood blocking and backing for support of accessories, wall cabinets, finish hardware.
- B. Related work specified elsewhere:
  - 1. Concrete Formwork, Section 03 10 00.
  - 2. Metal Fabrications, Section 05 50 00.
  - 3. Finish Carpentry, Section 06 20 00.

**1.02 REFERENCES, CODES AND STANDARDS:** The following references, codes and standards are hereby made a part of this Section. Work shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings. Latest adopted edition of references and codes adopted by the Governing Agency shall apply. Nothing contained herein shall be construed as permitting work that is contrary to code requirements.

- A. ALSC (American Lumber Standards Committee) - Softwood Lumber Standards.
- B. APA (American Plywood Association) - Guide to Plywood Grades.
- C. ASTM A307 - Carbon Steel Externally Threaded Standard Fasteners.
- D. ASTM D3498 - Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems.
- E. AWWA (American Wood Preservers Association) - Book of Standards.
- F. DFPA (Douglas Fir Plywood Association)
- G. NLMA (National Lumber Manufacturers Association) - National Design Specification for Stress-Grade Lumber and Its Fastenings.
- H. WCLIB (West Coast Lumber Inspection bureau) - Standard Grading Rules 16
- L. WWPA (Western Wood Products Association) - Western Lumber Grading Rules
- M. ANSI / AF & PA (American National Standards Institute / American Forest & Paper Association) – National Design Standard for Wood Construction (NDS).
- N. International Building Code (IBC) with State of California Amendments, California Building Code (CBC).

**1.03 QUALITY ASSURANCE:**

- A. Lumber Grading Agency: Certified by ALSC.
- B. Plywood Grading Agency: Certified by APA.
- C. Inspection Agencies:
  - 1 WCLIB – West Coast Lumber Inspection Bureau
  - 2 WWPA – Western Wood Products Association

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- A. Single-Source Responsibility for Engineered Wood Products: Obtain each type of engineered wood products from one source from a single manufacturer.

**1.04 SUBMITTALS:**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Submit manufacturer's literature describing products.
- C. Samples: Only as requested by the Architect.
- D. Manufacturer's Certificates: Submit certificates of compliance with standards noted.

**1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING:**

- A. Store and protect products under provisions of Section 01 60 00.
- B. Provide proper facilities for handling and storage of materials to prevent damage to edges, ends, and surfaces.
- C. Deliver and store packaged products in original containers or bundles with seals unbroken and labels intact until time of use.
- D. Keep materials dry. Where necessary, stack materials off ground on level flat forms, fully protected from weather.
- E. Protect 'kiln-dried' and 'S-Dry' materials from moisture. Separate from contact with soil or earth.

**PART 2 - PRODUCTS**

**2.01 DIMENSIONED LUMBER**

- B. Dimensioned Lumber: Provide lumber manufactured in compliance with PS 20 - American Softwood Lumber Standard and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.
- C. Lumber Species and Grades: Wood species and stress grades as noted on the (structural) drawings and specified below. Regrade large members when cut or ripped.
- D. Lumber Markings:
  - 1. Provide lumber with each piece factory-marked with grade stamp of inspection agency, evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
  - 2. For exposed lumber furnish pieces with grade stamps applied to ends or back of each piece; or omit grade stamps entirely and provide certificates of grade compliance issued by inspection agency.
- E. Lumber Sizes: Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.
- F. Lumber for Load-Bearing Members: Species as indicated on the structural drawings, conforming to WCLIB or WWPA grading standards as applicable.
- G. Surfacing: Provide dressed lumber, S4S, unless otherwise indicated.
- H. Moisture Content: All lumber shall have moisture content as specified below. Air season in place, protected from rain and high humidity conditions, no less than 15 days before applying finish materials.
  - 1. Concealed lumber: Provide dry lumber with 19 percent maximum moisture content at time of making connections, unless otherwise indicated.
  - 2. Exposed lumber and timber: Provide dry lumber with 15 percent maximum moisture content at time of delivery, unless otherwise indicated.
- I. Sill Plates: Pressure preservative treated, No. 1 or Better, Douglas Fir.

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- J. Exposed Framing: Provide material complying with the following requirements:
  - 1. Definition: Exposed framing refers to dimension lumber that is not concealed by other construction and is indicated to receive a stained or natural finish.
  - 2. Grading: Material hand-selected at factory from lumber of species and grade indicated below that complies with appearance grade requirements of ALSC National Grading Rule; issue inspection certificate of inspection agency for selected material.
  - 3. Species: Provide same species and grade as indicated for structural framing.
- K. Non-load Bearing Framing and Furring: Douglas fir-larch, No. 1 and better grade, unless otherwise indicated on drawings.
- L. Miscellaneous Framing: For site structures and other exposed conditions, provide No. 1 grade douglas fir-larch or better, selected for appearance. At site structures, provide light sandblast finish on exposed wood framing.
- M. Wane: Limit wane to five percent of members in accordance with WWPA standards. Do not locate members with wane at plywood sheathing joints, at solid blocking or at double plates.

**2.02 STRUCTURAL PANELS**

- A. Plywood Materials, General: APA Performance-Rated Panels, Group 1 Series, PS 1, species and thickness as indicated on drawings and as specified herein.
- N. Plywood Panels for Roof Sheathing: Douglas fir, Structural I, APA STRUCTURAL RATED SHEATHING.
  - 1. Exposure Durability Classification: EXTERIOR.
  - 2. Thickness: As indicated on the drawings.
  - 3. Edge detail: Square if all edges supported on framing or tongue-and-groove (T&G) if edges are unsupported. Plyclips will not be acceptable.
- O. Plywood Panels for Wall Sheathing: Douglas fir, Structural I, APA RATED SHEATHING.
  - 1. Exposure Durability Classification: EXTERIOR.
  - 2. Thickness: As indicated on the drawings.
  - 3. Edge detail: Square.
- D. Oriented Strand Board (OSB) Panels for Wall Sheathing, Floors or Roofs: APA Structural Rated Sheathing confirming to PS-2.

**2.03 ACCESSORIES:**

- A. Rough Hardware: Exterior hardware nails and fasteners shall be hot-dipped galvanized, plain finish for interior locations, size and type to suit application. Nails to be common nails or ICBO approved equivalent, unless authorized otherwise in writing.
- B. Bolts: Hexagonal heads, Grade A conforming to ASTM A307; galvanized for exterior, exposed applications only.
- C. Lag Screws, Lag Bolts and Wood Screws: Meet requirements of NDS.
- D. Nails, Typical: Common wire, sizes as indicated on drawings and as required by California Building Code (CBC).
  - 1. No box nails shall be used.
  - 2. Machine applied nailing shall be subject to approval as specified on the drawings and as approved by Authority Having Jurisdiction (AHJ).

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- E. Washers: Washers for bearing against wood shall be provided under all bolt heads, lag screw heads, and nuts. Malleable iron or steel plate having an area equal to 16 times the area of bolt or lag screw. Steel washers shall have a thickness not less than 1/10 the length of the washer's longest side. Malleable iron washers shall have a thickness not less than 1/2 the bolt or lag screw diameter and having a bearing surface for the nut or head equal in diameter and having a bearing surface for the nut or head equal in diameter to not less than the long diameter of the nut or head.
- F. Powder Driven Fasteners: Tempered steel pins with special corrosive-resistant plating or coating. Pins shall have guide washers to accurately control penetration, maximum 3/4 inch. Fastening shall be accomplished by low-velocity piston-driven powder-actuated tool. Pins and tool shall be same as manufactured by Hilti Fastening Systems; Impex Tool corporation; or equal product substituted under provisions of Division 01.
- G. Expansion Anchors: Hot dipped galvanized carbon steel or stainless steel. Wedge anchors shall be the same as Hilti, Inc.'s "KB-TZ", Ramset/Red Head's "Trubolt" or Simpson Strong-Tie "Strong Bolt 2".
- H. Fabricated Sheet Metal Timber Framing Connectors: Fabricate from hot-dipped galvanized steel. Connectors shall be at least 20 gauge material (1/8 inch plate materials where welded), unless otherwise noted, punched for nailing. Nails and Nailing shall conform to the manufacturer's instructions with a nail provided for each punched hole. Types as noted on the drawings. Same as Simpson Co.; KC metal Products; or equal product substituted under provisions of Division 01.
- I. Glue: Conforming to ASTM D3498 and APA Performance Specification AFG-01.

## 2.04 WOOD TREATMENT:

- A. Materials:
  - 1. Wood Preservative Pressure Treatment: AWPA Standards U1 and T1.
  - 2. Wood Preservative Surface Application: For interior use; Bora-Care manufactured by Nisus Corp. For exterior use; Copper Green, manufactured by Green Products or Tenino, manufactured by Poles, Inc.
  - 3. Fire Retardant Pressure Treatment: AWPA Standards U1,T1, P49 and P50.
- B. Shop Preservative Treatment of Wood Materials:
  - 1. Provide preservative pressure treatment for lumber located within 1-1/2 inches of concrete on grade, exposed, in contact with ground, in contact with bituminous roofing, waterproofing, and related metal flashings, and where noted on Drawings.
  - 2. Lumber: Treat in accordance with AWPA Standard U1, Use Category UC2 for indoor, UC3B for exterior and UC4C for exterior in contact with ground.
  - 3. Plywood: Treat in accordance with AWPA Standard U1, Use Category UC3B.
- C. Shop Fire Retardant Treatment of Wood Materials:
  - 1. Provide fire retardant pressure treatment for lumber for all framing in non-combustible construction building types.
  - 2. Lumber: Treat in accordance with AWPA Standard U1, Use Category UCFA for interior and UCFB for exterior.
  - 3. Plywood: Treat in accordance with AWPA Standard U1, Use Category UCFA.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Coordination:
  - 3. Coordinate placement of framing connectors and supports with applied finishes to minimize bowing and cutouts.

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4. Coordinate framing and sheathing with installation of glue laminated structural units and other engineered wood framing members. ducts and conduits to avoid penetrations through load-bearing framing.
5. Coordinate framing with plumbing, mechanical and electrical work to provide means to support components and equipment and to provide suitable openings through framing.
6. Request direction from Architect for all openings through stud, rafter and joist framing exceeding 24-inches in any direction if opening framing are not detailed on drawings.

### 3.02 WOOD FRAMING

- A. Wood Framing Members: Provide framing members sized as indicated on drawings or, if not indicated, in accordance with California Building Code (CBC).
- B. Wood Framing Erection: Erect wood framing members level and plumb, or to indicated slope. Place horizontal members flat, with crown side-up. Construct framing members full length without splices, except as noted.
- C. Sill and Head Plates, Typical:
  1. Provide single bottom plate and double top plates, nominal 2-inches thick by width of studs. Provide nominal 3-inch bottom plates where indicated on drawings.
  2. Overlap double plates minimum of 4 feet or as indicated on drawings and at corners and intersections. Face nail upper plate to lower top plate as indicated on drawings.
  3. Provide nominal 3-inch bottom plates where indicated on drawings. Nail bottom plate to wood framing with indicated sill nailing. Anchor bottom plate to concrete structure with anchor bolts. Expansion bolts will not be permitted at load-bearing conditions.
  4. Install pressure preservative treated lumber for sill plates in accordance with California Building Code (CBC) Section 2303.
    - a. Bolt sills to foundations and slabs. Level sills with shims, washers placed, and nuts tightened to level bearing.
    - b. Pack space between sill and concrete with dry-pack cement grout mixed at a ration of 1.0 part cement to 3.0 parts sand, by volume, with only enough water for placement and hydration.
- D. Studs:
  1. Toenail studs to bottom plate and end nail to lower top plate.
  2. Provide triple studs at corners and partition intersections.
  3. Provide additional studs at corners and intersections as necessary to secure sheathing, gypsum board and other applied components.
  4. Anchor studs abutting concrete and masonry with 5/8-inch diameter anchor bolts, spaced maximum 48-inches on center or as indicated on drawings.
- E. Posts and Columns:
  1. Align surfaces on posts flush with wall surface for installation of interior finish materials.
  2. At built-up posts, arrange and nailed together as indicated and in accordance with Code requirements for construction type.
  3. Erect posts straight and plumb.
- F. Beams and Girders:
  1. Install beams and girders with crown edges up.
  2. Frame as indicated on drawings.
  3. Provide solid bearing at ends of each member.



4. Nail built-up beams and girders with two rows of 20d nails spaced maximum of 16-inches on center. locating one row near top edge and other near bottom edge of member.
- G. Joists from Lumber:
1. Install joists with crown edges up.
  2. Support ends of each member minimum 1-1/2 inches of bearing on wood.
  3. Provide double joist headers at floor, ceiling and roof openings. Provide double joists under wall and parapet studding and under curbs.
  4. Fit solid blocking at ends of members.
- H. Openings and Recesses:
1. Provide double or triple studs as noted on drawings and headers at all openings and recesses.
  2. Double members at openings over 18-inches in width or height.
  3. Space short studs over and under opening to maintain stud spacing continuity.
- I. Headers:
1. Provide continuous headers, same width as studs and of depth required to span widest opening.
  2. Toenail headers to studs and opening framing or provide hangers.
  3. Lap headers at intersections with bearing partitions or tie with metal straps.
  4. Frame rigidly into joists.
- J. Stud Blocking:
1. Install blocking in continuous horizontal row at mid-height of unsheathed single story partitions over 8 feet high and in all multi-story partitions, for structural rigidity.
  2. Coordinate blocking with anchoring provisions for products attached to walls, as specified in other Sections.
- K. Joist and Rafter Blocking:
1. Block joist and rafter ends with solid blocking, nominally 2-inches thick by depth of member.
  2. Also block joists and rafters at all locations where members cross bearing points.
- L. Joist and Rafter Bridging:
1. Where nominal depth-to-thickness ratio of joists exceeds 8-inches and span exceeds 10-feet, install solid bridging.
  2. Provide bridging of nominal 2-inch width by joist or rafter depth.
  3. Install blocking offset to permit toe-nailing or end-nailing.
  4. Bridging shall comply with the following, unless otherwise indicated on drawings.
- | <u>Span</u> _____        | <u>Bridging</u>                                    |
|--------------------------|--|
| Spans to 10 feet         | None required, except as noted above               |
| Spans 10 feet to 20 feet | One row at midspan                                 |
| Spans over 20 feet       | Rows evenly spaced, not exceeding 8 feet on center |
- M. Fire Blocking: Firestop furred spaces in walls at each floor level and at ceiling line of top story, with wood blocking accurately fitted to close spaces. Conform to California Building Code (CBC) and notes on structural drawings.
- N. Fastening, General: Drill holes for fasteners and size as noted.
1. Nails and spikes: Smaller than diameter of fastener. Pre-drill as necessary to prevent splitting.

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2. Lag bolts: Drill holes same diameter and length as shank. Bit size shall be no larger than base of threaded portion of bolt.
  3. Bolts: Holes shall be 1/32- to 1/16-inch larger than bolt.
  4. Powder-driven fasteners: Do not install on curbs or at edge of slab closer than as noted in applicable ICC Evaluation Service, Inc., Evaluation Report.
- O. Nailing: As indicated on the drawings. If not indicated, conform to California Building Code (CBC).
1. Spacing: 1/2 length of nail minimum.
  2. Edge distance: 1/4 length of fastener.
  3. Toe nailing: Drive toe nails at angle or approximately thirty degrees with the piece and started approximately one-third the length of the nail from end of piece.
  4. Replace split or otherwise damaged structural members.
- P. Framing Connectors: Drive nails into all holes of each connector. Install bolts in each framing connector unless detailed otherwise. Where hole is smaller than diameter of fastener, predrill as required to prevent splitting.
- Q. Bolts: Use standard cut washer under bolt heads and nuts against wood. Use heavy plate washer or malleable iron washer where noted on drawings. Drive into place. Ensure full engagement of nut, but projection of bolt beyond nut not to exceed one bolt diameter. Tighten nuts at installation and again immediately prior to enclosure.
- R. Lag Bolts: Turn into place without driving. Ensure penetration into lagged member of 60 percent of bolt length. Lead hole shall have diameter of about 70 percent of the roof diameter of the bolt. Provide washers of same size as specified for bolts.
- S. Expansion Anchor Bolts: Install anchors in snug fitting, smoothly drilled holes, in accordance with the manufacturer's written instructions. Install expansion bolts so that load acts on bolts in shear rather than withdrawal.
- T. Hold-Down Anchors:
1. Provide minimum of 1-inch vertical clearance at bottom of all anchors from sill plate.
  2. All bolts in post for hold-down installation shall have plate washers installed beneath nuts and bolt heads.
- U. Bolt Retightening: Retighten all bolts prior to closing-in walls.

### 3.03 SHEATHING:

- V. Installation of Construction Panels, General: Comply with applicable recommendations contained in APA Form No. E30 - APA Design/Construction Guide - Residential & Commercial, for types of construction panels and applications indicated.
- W. Draftstops: Provide draftstops at attic spaces in conformance to California Building Code (CBC) and as indicated on the drawings. Use plywood or gypsum board, as permitted by California Building Code (CBC). See Section 09 21 16 - Gypsum Board for gypsum board.
- X. Fastening Methods: Nail or screw panels to supports. Additionally, use construction adhesive where construction panels will serve as wall paneling or true panel surface is required.

- Y. Sheathing Installation, General:
  - 1. Stagger end joints to avoid four-corner intersections.
  - 2. Allow minimum 1/8-inch space between end joints and 1/8-inch at edge joints for expansion and contraction of panels, typically.
  - 3. At OSB, allow 1/2-inch gap between concrete or masonry and OSB panel.
  - 4. Provide panels not less than 8 square feet in area and with no dimension less than 24-inches, in compliance with California Building Code (CBC).
- Z. Roof Sheathing:
  - 1. Provide panel thickness and index as indicated on drawings.
  - 2. At flat roofs, either install square edge plywood roof sheathing with long dimension parallel to framing, with end joints occurring over framing or lumber blocking only. Fully support panel cut edges and all ends with lumber blocking. Plyclips will not be accepted.
  - 3. Provide wood filler strips on top of framing anchors and other elements which require cut-outs of plywood, to create level surface on which roofing and underlayment may be applied.
- AA. Wall Sheathing:
  - 1. Provide panel thickness as indicated on drawings.
  - 2. For lateral bracing walls, install wall sheathing as noted on drawings.
  - 3. For plywood sheathing used as backing support and not lateral bracing, install wall sheathing with long edge parallel to framing members. End joints do not require blocking.
- BB. Sheathing Nailing: Conform to California Building Code (CBC) and notes on structural drawings.
  - 1. Use of machine nailing shall be subject to a satisfactory jobsite demonstration for each project and shall be subject to approval by Architect (Structural Engineer) and Authority Having Jurisdiction (AHJ). Approval shall be subject to continued satisfactory performance.
  - 2. Machine nailing will not be approved for plywood 5/16-inch thick and less.
  - 3. If nailheads penetrate the outer ply more than would be normal for hand hammer or if minimum allowable edge distances are not maintained, machine nailing will be determined to be unsatisfactory and machine nailing shall be discontinued.
- I. In general, provide nail penetration into the piece receiving the point of not less than 1/2 the length of the nail or spike provided; however, 16d nails may be used to connect two pieces of 2 inch (nominal) thickness.
- J. In diaphragms, the minimum penetration shall be 1-1/2 inches for 8d nails and 1-5/8 inches for 10d nails.
- K. Perform nailing without splitting wood, preboring as required; replace split members.
- L. Drill bolt holes 1/16 inches larger in diameter than the bolts being used; drill straight and true from one side only.
- M. Bolt threads must not bear on wood; use washers under head and nut where bolts bear on wood; use washers under nuts.
- N. Lag screw anchorage embedment in piece lagged to shall not be less than 0.6 times lag screw length nor less than 8 times lag screw diameter.
- O. Prebore holes for lag screws same diameter as root of thread; enlarge holes to shank diameter for length of shank.
- P. Do not drive lag screws.

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**3.01 SITE TREATMENT OF WOOD MATERIALS:**

- A. Apply non-pressure wood preservative to lumber and plywood embedded in and placed against concrete.
- B. Apply non-pressure wood, preservative to cut sides and bolt holes drilled in treated wood.

**3.02 TOLERANCES:**

- A. Framing Members: 1/4 inch maximum from true position.
- B. Surface Flatness of Floor: 1/4 inch in 10 feet maximum.

**END OF SECTION**

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**SECTION 064100  
ARCHITECTURAL WOOD CASEWORK**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Specially fabricated cabinet units.
- B. Countertops.
- C. Hardware.
- D. Preparation for installing utilities.

**1.02 REFERENCE STANDARDS**

- A. AWI (QCP) - Quality Certification Program Current Edition.
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards 2021, with Errata.
- C. BHMA A156.9 - Cabinet Hardware 2020.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
  - 1. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
  - 2. Include certification program label.
- C. Product Data: Provide data for hardware accessories.
- D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.
- E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.
- F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

**1.04 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
  - 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
  - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Quality Certification:
  - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: [www.awiqcp.org/#sle](http://www.awiqcp.org/#sle).
  - 2. Provide designated labels on shop drawings as required by certification program.
  - 3. Provide designated labels on installed products as required by certification program.
  - 4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
  - 5. Replace, repair, or rework all work for which certification is refused.
- C. Operable parts for all accessible casework shall comply with CBC Section 11B-309.
  - 1. Provide U-shaped pulls or touch latches at all accessible casework.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Protect units from moisture damage.

**1.06 FIELD CONDITIONS**

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- 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 CABINETS**

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.

### **2.02 WOOD-BASED COMPONENTS**

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

### **2.03 LAMINATE MATERIALS**

- A. Manufacturers:
  1. Panolam Industries International, Inc; Pionite Standard HPL: [www.panolam.com/#sle](http://www.panolam.com/#sle).
  2. Wilsonart LLC: [www.wilsonart.com/#sle](http://www.wilsonart.com/#sle).

### **2.04 COUNTERTOPS**

- A. Countertops are specified in Section 123600.

### **2.05 ACCESSORIES**

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Fasteners: Size and type to suit application.
- C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- D. Fixed Specialty Shelf Supports:
- E. Concealed Joint Fasteners: Threaded steel.
- F. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.
  1. Material: Steel.

### **2.06 HARDWARE**

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Adjustable Shelf Supports: Standard back-mounted system using surface mounted metal shelf standards and coordinated cantilevered shelf brackets, satin chrome finish, for nominal 1 inch spacing adjustments.
- C. Fixed Standard Shelf, Countertop, and Workstation Brackets:
  1. Material: Steel.
  2. Finish: Manufacturer's standard, factory-applied primer.
  3. Finish: Manufacturer's standard, factory-applied, textured powder coat.
  4. Finish: Brushed.
  5. Color: Selected by Architect from manufacturer's standard range.
  6. Color: Black.
  7. Products:
    - a. A&M Hardware, Inc ; Standard Brackets: <http://www.aandmhardware.com/#sle>.
    - b. A&M Hardware, Inc ; Stainless Steel Standard Brackets: <http://www.aandmhardware.com/#sle>.
    - c. A&M Hardware, Inc ; Aluminum Brackets: <http://www.aandmhardware.com/#sle>.
- D. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers.
- E. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
- F. Catches: Magnetic.

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- G. Drawer Slides:
1. Type: Standard extension.
  2. Static Load Capacity: Commercial grade.
  3. Mounting: Side mounted.
  4. Stops: Integral type.
  5. Features: Provide self closing/stay closed type.
  6. Manufacturers:
    - a. Accuride International, Inc; Light-Duty Drawer Slides: [www accuride.com/#sle](http://www accuride.com/#sle).
    - b. Accuride International, Inc; Heavy-Duty Drawer Slides: [www accuride.com/#sle](http://www accuride.com/#sle).
    - c. Grass America Inc; Ball Bearing Slide System: [www grassusa.com/#sle](http://www grassusa.com/#sle).
    - d. Grass America Inc; Epoxy Drawer Slide System: [www grassusa.com/#sle](http://www grassusa.com/#sle).
    - e. Grass America Inc; Dynapro: [www grassusa.com/#sle](http://www grassusa.com/#sle).
    - f. Grass America Inc; Elite Plus: [www grassusa.com/#sle](http://www grassusa.com/#sle).
    - g. Grass America Inc; Maxcess: [www grassusa.com/#sle](http://www grassusa.com/#sle).
    - h. Hettich America, LP; Quadro: [www hettich.com/#sle](http://www hettich.com/#sle).
    - i. Knappe & Vogt Manufacturing Company; Light-Duty Drawer Slides: [www knapeandvogt.com/#sle](http://www knapeandvogt.com/#sle).
    - j. Knappe & Vogt Manufacturing Company; Medium-Duty Drawer Slides: [www knapeandvogt.com/#sle](http://www knapeandvogt.com/#sle).
    - k. Knappe & Vogt Manufacturing Company; Heavy-Duty Drawer Slides: [www knapeandvogt.com/#sle](http://www knapeandvogt.com/#sle).
- H. Hinges: European style concealed self-closing type, steel with polished finish.
1. Manufacturers:
    - a. Grass America Inc; Institutional Hinges: [www grassusa.com/#sle](http://www grassusa.com/#sle).
    - b. Grass America Inc; TEC Self-Close: [www grassusa.com/#sle](http://www grassusa.com/#sle).
    - c. Grass America Inc; TEC Soft-Close: [www grassusa.com/#sle](http://www grassusa.com/#sle).
    - d. Grass America Inc; Tiomos Hinge System: [www grassusa.com/#sle](http://www grassusa.com/#sle).
    - e. Grass America Inc; Nexis Hinge System: [www grassusa.com/#sle](http://www grassusa.com/#sle).
    - f. Hardware Resources: [www hardwareresources.com/#sle](http://www hardwareresources.com/#sle).
    - g. Hettich America, LP; Sensys: [www hettich.com/#sle](http://www hettich.com/#sle).
    - h. Blum, Inc: [www blum.com/#sle](http://www blum.com/#sle).
- I. Sliding Door Track Assemblies: Upper and lower track of satin anodized aluminum, with matching shoe equipped with nylon rollers.
- J. Elbow Catches: BHMA A156.9, B03023; coordinate with locks and latches at pairs of doors; active leaf shall have lock and inactive leaf shall have elbow catch. Ives #215, plated cast iron.
- K. Drawer Stops: Provide stops to prevent drawer fronts from hitting face of cabinet.
- L. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063.

## 2.07 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
  1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
  2. Cap exposed plastic laminate finish edges with material of same finish and pattern.

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- E. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches on center.
- F. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.
- G. Shop glaze glass materials using the Interior Dry method as specified in Section 088000.

## **2.08 SHOP FINISHING**

- A. Sand work smooth and set exposed nails and screws.
- B. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

### **3.02 INSTALLATION**

- A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use fixture attachments in concealed locations for wall mounted components.
- D. Use concealed joint fasteners to align and secure adjoining cabinet units.
- E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- F. Secure cabinets to floor using appropriate angles and anchorages.
- G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.
- H. Site glaze glass materials using the Interior Dry method specified in Section 088000.

### **3.03 ADJUSTING**

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

### **3.04 CLEANING**

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

**END OF SECTION**



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**SECTION 068316  
FIBERGLASS REINFORCED PANELING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 REFERENCE STANDARDS**

- A. 9 CFR 416.2 - Regulatory Requirements Under the Federal Meat Inspection Act and the Poultry Products Inspection Act, Part 416-Sanitation current edition.
- B. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics 2010 (Reapproved 2018).
- C. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor 2013a.
- D. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2021.
- E. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels 2017.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

**1.03 SUBMITTALS**

- A. See Section 013000 - 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).
  - 4. Panolam Industries International, Inc; Panolam FRP: [www.panolam.com/#sle](http://www.panolam.com/#sle).

**2.02 PANEL SYSTEMS**

- A. Wall Panels:
  - 1. Panel Size: 4 by 8 feet.
  - 2. Panel Thickness: 0.10 inch.
  - 3. Surface Design: Smooth.
  - 4. Color: White.
  - 5. 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.
  - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

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3. Scratch Resistance: Barcol hardness score greater than 35, when tested in accordance with ASTM D2583.
  4. Impact Strength: Greater than 6 ft lb force per inch, when tested in accordance with ASTM D256.
  5. Sanitation and Cleanability: Comply with 9 CFR 416.2.
- B. Trim: Vinyl; color coordinating with panel.
  - C. Fasteners: Nylon rivets.
  - D. Adhesive: Type recommended by panel manufacturer.
  - E. Sealant: Type recommended by panel manufacturer; white.

**PART 3 EXECUTION**

**3.01 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. Pre-drill fastener holes in panels, 1/8 inch greater in diameter than fastener, spaced as indicated by panel manufacturer.
- D. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.
- E. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
- F. Install panels with manufacturer's recommended gap for panel field and corner joints.
- G. Drive fasteners to provide snug fit, and do not over-tighten.
- H. Place trim on panel before fastening edges, as required.
- I. Fill channels in trim with sealant before attaching to panel.
- J. Install trim with adhesive and screws or nails, as required.
- K. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.
- L. Remove excess sealant after paneling is installed and prior to curing.

**END OF SECTION**

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**SECTION 071300  
SHEET WATERPROOFING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Sheet Waterproofing:
  1. Below grade bituminous sheet membrane with aluminum backing

**1.02 ABBREVIATIONS**

**1.03 REFERENCE STANDARDS**

- A. NRCA (WM) - The NRCA Waterproofing Manual 2021.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for membrane.
- C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- D. Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

**1.05 QUALITY ASSURANCE**

- A. Membrane Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

**1.06 FIELD CONDITIONS**

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

**1.07 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.
- C. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

**PART 2 PRODUCTS**

**2.01 WATERPROOFING APPLICATIONS**

- A. Below Grade Bituminous Sheet Membrane with Aluminum Backing:
  1. Cover with protection board.

**2.02 MEMBRANE MATERIALS**

- A. Below Grade Bituminous Sheet Membrane with Aluminum Backing:
  1. Thickness: 60 mil (0.060 inch), minimum.
  2. Sheet Width: 39-3/8 inches.
  3. Tear Strength: Greater than 2.7 pounds.
  4. Heat Resistance: No displacement sag or dripping after 2 hours at 158 degrees F.
  5. Water Permeability: Impermeable.
  6. Low Temperature Flexibility: No cracking at 5 degrees F.

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7. Shipping Weight: 85 pounds per roll.
8. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
9. Manufacturers:
  - a. AVM Industries, Inc; Aussie Membrane 580-AL: [www.avmindustries.com/#sle](http://www.avmindustries.com/#sle).
- B. Self-Adhered HDPE Sheet Membrane: Recommended by manufacturer for placement below concrete slabs and on outside face of below grade walls before placement of concrete.
  1. Sheet Thickness: 32 mil (0.032 inch), minimum.
  2. Termite Resistance: 100 percent when tested in accordance with ICC-ES AC380.
  3. Low Temperature Flexibility: Unaffected when tested according to ASTM D1970/D1970M at minus 20 degrees F, 180 degree bend on 1 inch mandrel.
  4. Hydrostatic Resistance: Resists the weight of 231 feet when tested according to ASTM D5385/D5385M.
  5. Elongation at Break: 500 percent, minimum, measured according to ASTM D412.
  6. Tensile Strength, Film: 3,500 pounds per square inch, minimum, measured according to ASTM D412.
  7. Lap Peel Adhesion: 8 pounds per inch, minimum, when tested according to ASTM D1876.
  8. Water Vapor Permeance: 0.01 perm, maximum, measured in accordance with ASTM E96/E96M.
  9. Lateral Water Migration Resistance: Resists the weight of 231 feet when tested according to ASTM D5385/D5385M.
  10. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
  11. Manufacturers:
    - a. AVM Industries, Inc; Aussie Skin 550: [www.avmindustries.com/#sle](http://www.avmindustries.com/#sle).
    - b. GCP Applied Technologies; Preprufe 300R Plus: [www.gcpat.com/#sle](http://www.gcpat.com/#sle).
    - c. GCP Applied Technologies; Preprufe 300R: [www.gcpat.com/#sle](http://www.gcpat.com/#sle).
    - d. GCP Applied Technologies; Preprufe 160R Plus: [www.gcpat.com/#sle](http://www.gcpat.com/#sle).
    - e. GCP Applied Technologies; Preprufe 160R: [www.gcpat.com/#sle](http://www.gcpat.com/#sle).
    - f. Polyguard Barrier Systems, Inc, a division of Polyguard Products, Inc; TERM Underslab Barrier: [www.polyguardbarriers.com/#sle](http://www.polyguardbarriers.com/#sle).
- C. Seaming Materials: As recommended by membrane manufacturer.
- D. Termination Bars: Aluminum; compatible with membrane and adhesives.
- E. Adhesives: As recommended by membrane manufacturer.
- F. Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with sheet membrane.

### 2.03 ACCESSORIES

- A. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.
- B. Protection Board: Provide type capable of preventing damage to waterproofing due to backfilling and construction traffic.
  1. Hardboard, 1/8 inch thick.
  2. Asphalt impregnated wood fiberboard, 1/4 inch thick.
  3. Multi-layer internally-reinforced asphaltic panels, 1/8 inch thick, nominal, complying with ASTM D6506/D6506M.
- C. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.
  1. Composition: Dimpled polystyrene core; polypropylene filter fabric.
    - a. Products:
      - 1) Epro Services, Inc; ECODRAIN-MS: [www.eproserv.com/#sle](http://www.eproserv.com/#sle).

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- 2) Mar-flex Waterproofing & Building Products; ArmorDrain 110: [www.mar-flex.com/#sle](http://www.mar-flex.com/#sle).
  - 3) Mar-flex Waterproofing & Building Products; ArmorDrain 150: [www.mar-flex.com/#sle](http://www.mar-flex.com/#sle).
  - 4) Mar-flex Waterproofing & Building Products; ArmorDrain 400 Protection/Drainage Board: [www.mar-flex.com/#sle](http://www.mar-flex.com/#sle).
  - 5) W.R. Meadows, Inc; Mel-Drain 5012: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
- D. Cant Strips: Premolded composition material.
- E. Flexible Flashings: Type recommended by membrane manufacturer.
- F. Counterflashings: Galvanized steel sheet, [ ] inch thick.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
- C. Verify items that penetrate surfaces to receive waterproofing are securely installed.

#### **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; vacuum substrate clean.
- C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
- D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.
- E. Seal moving cracks with sealant and non-rigid filler, using procedures recommended by sealant and waterproofing manufacturers.
- F. Prepare building expansion joints at locations as indicated on drawings.
- G. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.
- H. Concrete Surfaces for Adhesive Bonding: Prepare concrete substrate according to ASTM D5295/D5295M.
  1. Remove substances that inhibit adhesion including form release agents, curing compounds admixtures, laitance, moisture, dust, dirt, grease and oil.
  2. Repair surface defects including honeycombs, fins, tie holes, bug holes, sharp offsets, rutted cracks, ragged corners, deviations in surface plane, spalling and delaminations, as described in the reference standard.
  3. Remove and replace areas of defective concrete as specified in Section 033000.
  4. Prepare concrete for adhesive bonded waterproofing using mechanical or chemical methods described in the referenced standard.
  5. Test concrete surfaces as described in the referenced standards. Verify surfaces are ready to receive adhesive bonded waterproofing membrane system.

#### **3.03 INSTALLATION - MEMBRANE**

- A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- B. Roll out membrane, and minimize wrinkles and bubbles.
- C. Self-Adhering Membrane: Remove release paper layer, and roll out onto substrate with a mechanical roller to provide full contact bond.
- D. Overlap edges and ends, minimum 3 inches, seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.

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- E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
- F. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.
- G. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
- H. Seal membrane and flashings to adjoining surfaces.

#### **3.04 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD**

- A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions.
- B. Place protection board directly against drainage panel; butt joints. Scribe and cut boards around projections, penetrations, and interruptions.
- C. Adhere protection board to substrate with compatible adhesive.

#### **3.05 PROTECTION**

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

**END OF SECTION**

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**SECTION 072500  
WEATHER BARRIERS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Water-Resistive Barrier: Under exterior wall cladding, over sheathing or other substrate; not air tight or vapor retardant.

**1.02 DEFINITIONS**

- A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
- B. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture resistant, to the degree specified, intended to be installed to shed water without sealed seams.

**1.03 REFERENCE STANDARDS**

- A. AATCC Test Method 127 - Test Method for Water Resistance: Hydrostatic Pressure 2018, with Editorial Revision (2019).
- B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection 2021.
- C. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers 2016, with Editorial Revision (2019).

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on material characteristics.
- C. Shop Drawings: Provide drawings of special joint conditions.

**1.05 FIELD CONDITIONS**

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

**PART 2 PRODUCTS**

**2.01 WEATHER BARRIER ASSEMBLIES**

- A. Water-Resistive Barrier: Provide on exterior walls under exterior cladding.
  - 1. Use building paper unless otherwise indicated.
  - 2. Under Portland cement stucco, use two separate layers of building paper.

**2.02 WATER-RESISTIVE BARRIER MATERIALS (NEITHER AIR BARRIER OR VAPOR RETARDER)**

- A. Building Paper: Asphalt-saturated Kraft building paper complying with requirements of ICC-ES AC38 Grade D.
  - 1. Water Penetration Resistance: Withstand a water head of 21 inches, minimum, for minimum of five hours, when tested in accordance with AATCC Test Method 127.
  - 2. Manufacturers:
    - a. Fortifiber Building Systems Group; Super Jumbo Tex 60 Minute: [www.fortifiber.com/#sle](http://www.fortifiber.com/#sle).
    - b. Fortifiber Building Systems Group; HydroTex: [www.fortifiber.com/#sle](http://www.fortifiber.com/#sle).

**2.03 ACCESSORIES**

- A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.
- B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
  - 1. Composition: Modified bituminous sheet laminated to polyethylene sheet.

**PART 3 EXECUTION**

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### 3.01 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the work of this section.

### 3.02 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives in accordance with manufacturer's instructions.

### 3.03 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Water-Resistive Barriers: Install continuous barrier over surfaces indicated, with sheets lapped to shed water but with seams not sealed.
- C. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.
- D. Mechanically Fastened Sheets - On Exterior:
  - 1. Install sheets shingle-fashion to shed water, with seams generally horizontal.
  - 2. Overlap seams as recommended by manufacturer but at least 6 inches.
  - 3. Overlap at outside and inside corners as recommended by manufacturer but at least 12 inches.
  - 4. Attach to framed construction with fasteners extending through sheathing into framing. Space fasteners at 12 to 18 inches on center along each framing member supporting sheathing.
  - 5. Install water-resistive barrier over jamb flashings.
  - 6. Install air barrier and vapor retarder UNDER jamb flashings.
  - 7. Install head flashings under weather barrier.
  - 8. At openings to be filled with frames having nailing flanges, wrap excess sheet into opening; at head, seal sheet over flange and flashing.
- E. Openings and Penetrations in Exterior Weather Barriers:
  - 1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
  - 2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
  - 3. At openings to be filled with non-flanged frames, seal weather barrier to each side of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.
  - 4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.
  - 5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
  - 6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

### 3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Coordination of ABAA Tests and Inspections:
  - 1. Provide testing and inspection required by ABAA QAP.
  - 2. Notify ABAA in writing of schedule for air barrier work, and allow adequate time for testing and inspection.
  - 3. Cooperate with ABAA testing agency.
  - 4. Allow access to air barrier work areas and staging.
  - 5. Do not cover air barrier work until tested, inspected, and accepted.



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C. Do not cover installed weather barriers until required inspections have been completed.

**3.05 PROTECTION**

A. Do not leave paper- or felt-based barriers exposed to weather for longer than one week.

**END OF SECTION**

## SECTION 075430

### ADHERED THERMOPLASTIC (PVC) FELTBACK MEMBRANE ROOFING

#### PART 1 – GENERAL CONDITIONS

##### 1.1 DESCRIPTION

###### A. Summary:

Install an adhered thermoplastic (PVC) feltback membrane roof system, including, but not limited to, primed gypsum cover board, PVC membrane flashings, PVC metal edge/fascia flashing, and other components to comprise a weathertight roof system. The roof system shall comply with the herein specified roofing manufacturer's standard written and detail requirements. Note: Sika Sarnafil products and system installation requirements have been utilized as the basis of design for this project.

###### B. System Description:

1. Roofing Contractor shall coordinate with subcontractors performing remove and dispose of existing roof system. If Roofing Contractor is performing the removal of the existing roof system including all vertical flashings, pitch-pans and applicable sheet metal down to the structural plywood deck. This will also include removing the extra plywood sheathing layer at roof perimeter to allow reactivation of the existing integral gutter. All removal, hauling, and disposal procedures must be performed by a certified contractor and must meet or exceed all applicable Local and State requirements.
2. Roofing Contractor shall coordinate with subcontractors performing abatement work related to the roofing scope to reduce the time the existing facility is exposed to weather damage as a result of partial removal of roofing and/or sheet metal materials related to the existing roof system being removed.
3. Over the properly prepared plywood roof deck areas install a single layer of 1/4" thick pre-primed gypsum cover board with fiberglass mat facer. The cover board shall be installed directly over the plywood roof deck and shall be secured to the wood deck using Factory Mutual approved heavy duty fasteners and high field strength plates at a rate of 12 attachment plates and fasteners per 4'x8' board (one (1) every 2.667 square feet). Perimeter and corner attachment rates must be increased in accordance with Factory Mutual Data Sheets 1-28/29 requirements.
4. Install a layer of 60-mil thermoplastic (PVC) feltback membrane (EnergySmart Tan). The membrane shall be installed directly over the gypsum cover board and shall be adhered using VOC compliant, water-based adhesive. The membrane shall meet or exceed Cool Roof Rating Council (CRRC) requirements for Title 24 compliance.
5. Roofing Contractor shall coordinate with subcontractor installing the sheet metal gutter and downspouts on Buildings J and M.

6. Install new 60-mil fiberglass reinforced PVC flashing membrane liner at the existing integral perimeter gutter. PVC membrane liner shall be adhered using VOC compliant flashing adhesive. Membrane liner shall extend from the roof deck through the gutter and onto the adjacent roof deck and shall be fastened to the roof deck on both sides with manufacturer's approved membrane attachment bar/disc and #15 fastener at a rate not greater than 12" o.c. (both sides). Note: Replace any severely deteriorated existing sheet metal gutter and restore to condition suitable to receive the adhered PVC membrane liner. Any necessary repairs to the existing sheet metal gutter are an unforeseen condition and shall be an extra cost item.
7. Install new PVC clad metal around entire perimeter edge. The new clad metal shall have a minimum four-inch (4") attachment flange, seven and a half-inch (7.5") vertical face with additional three-quarter inch (3/4") hemmed "kick" at bottom edge. The edge metal shall be secured to the wood substrate using approved fastener screws at a spacing of six-inch (6") on-center, staggered. Install a continuous metal cleat (hook strip) and PVC membrane coverstrip in accordance with the Roofing Manufacturer's standard written and detail requirements and as indicated on project drawings. Clad Metal Color shall be EnergySmart "TAN". Note: Install PVC clad metal covers at all vertical joints in accordance with Roofing Manufacturer's standard requirements
8. At removable equipment curbs, install adhered 60-mil "asphalt-oil" resistant flashing membrane. Flashing membrane to be adhered to the properly prepared vertical substrate with approved flashing adhesive and carried up, over the top and down one and a half inches (1.5") on inside of existing curb. Membrane shall be fastened 12" on center at inside of curb. Reinstall equipment to top of curb set in approved urethane sealant and secure to curb using increased diameter, metal-capped grommeted fasteners at a spacing of eight inches (8") on-center. Where possible, use existing fastener holes when installing new fasteners. Seal any exposed fastener holes using approved urethane sealant.
9. At all non-removable equipment curbs, install adhered "asphalt-oil" resistant flashing membrane. Flashing membrane shall be adhered to properly prepared vertical substrate to the highest extent possible and terminated with 22 gauge GSM extender piece set in approved urethane sealant and fastened at 12" on center with metal-capped grommeted fasteners. GSM extender piece shall be extended up under existing counter flashing receiver.
10. Install adhered PVC flashing membrane up and over the top of existing screen wall support sleepers. Detach screen wall from existing sleepers and install adhered "asphalt-oil" resistant flashing membrane over existing sleeper. Install new 24 gauge GSM cap/cover over new membrane flashing and secure with metal cap grommeted fasteners at vertical face. Re-attach screen wall legs with new oversized lag bolts into pilot hole filled with approved sealant and seal screen wall lag fasteners.
11. Screen wall post attachment at top of penthouse (Bldg. K) are to be cleaned, prepped, and resealed with properly sized backer-rod and approved urethane sealant.
12. Install 60-mil asphalt-oil resistant PVC flashing membrane at existing roof hatch curbs. The flashing membrane shall be adhered to the properly prepared vertical substrate using V.O.C.

compliant adhesive. Membrane termination shall be performed using Roofing Manufacturer approved termination bar/reglet with one-part urethane sealant as indicated and in accordance with manufacturer's requirements.

13. All open (soil, vent, etc.) pipes shall be flashed utilizing "Vent Stack" detail with PVC membrane cap as indicated. Note: The use of clamps for membrane termination will not be accepted at open (non-connected) pipes.
14. All connected (conduit, gas, etc.) pipes will be flashed utilizing PVC membrane pipe flashing detail with additional 60 mil fiberglass reinforced PVC membrane storm collar set in approved sealant and clamped in place with stainless steel pipe clamp covering the primary pipe flashing.
15. Replace all existing roof drain clamping rings, bolts and debris strainers with new matching steel components. Existing drain bowl and clamping ring flange shall be thoroughly cleaned prior to reinstalling PVC flashing membrane and sealant. All primary and overflow roof drains to receive new asphalt/oil resistant flashing membrane target with one full tube of manufacturer approved urethane sealant between the new flashing membrane and drain bowl receiver flange. Flashing membrane target shall be hot-air welded to roof membrane and installed in accordance with manufacturer's "Clamping Ring Drain" flashing.
16. At all inside and outside corner locations, install prefabricated membrane flashings only.
17. At all rooftop electrical conduit, condensate piping, gas piping, etc., install new, prefabricated thermoplastic pipe supports as manufactured by Miro Industries, or pre-approved equal. The pipe supports shall be positioned at a maximum spacing as required allowing for continuous four inch (4") clearance above the finished roof surface. Properly secure the conduit/piping to the pipe support using approved metal straps. Install membrane protection layer between new piping supports and roof membrane.
18. Install 79-mil PVC walkway (Dark Grey color) at locations matching existing walkway layout and at locations indicated. The walkway tread shall be installed in accordance with the Roofing Manufacturer's standard written and detail requirements.
19. Perform all flashing and detail work in strict accordance with the roofing manufacturer's standard written and detail requirements (as indicated within the project detail drawings and/or specification requirements, those specific project requirements shall supersede any corresponding minimum/standard requirements).

C. Work Included:

The work includes but is not necessarily limited to the installation of:

1. Existing Roof Removal
2. Substrate Preparation.
3. Gypsum Cover Board.
4. Cover Board Attachment Plates and Fasteners
5. Flashing Membrane Adhesive.
6. Roof Membrane Adhesive.

7. Membrane Attachment Bars & Fasteners.
8. Thermoplastic (PVC) Feltback Roof Membrane.
9. Thermoplastic (PVC) Flashing Membrane.
10. Metal Flashings.
11. Sealants.
12. Roof Drains.
13. Equipment Access/Walkway Tread.
14. Prefabricated Pipe Supports (Miro Industries).

## 1.2 QUALITY ASSURANCE

- A. Pre-Roofing Conference and Inspection: After approval of submittals but prior to beginning installation of Work of this Section, the Owner's Representative shall hold a meeting at the site attended by the Roofing Applicator, Sheet Metal, Painting, and related Subcontractors, and the Roofing Material Manufacturer to describe in detail the roof system(s) to be installed and to establish agreement, coordination, and responsibilities among the involved trades.
- B. The roofing system shall be applied only by an Applicator authorized by the specified Roofing Manufacturer prior to bid. The Applicator shall have a minimum of five (5) years documented experience with the Roofing Manufacturer. The Owner's Representative reserves the right to request a list of reference projects to verify Applicator's performance/work history. All references must be of similar size and scope, and must be within 100 miles of this project.
- C. The Roofing Manufacturer shall have directly produced the specified field and flashing membranes for the number of years equal to, or greater than that of the warranty term (20 years). The membrane shall have also maintained a consistent base formulation for the same number of years.
- D. The Roofing Manufacturer shall have a *Sustainable Product Certification* conforming to the requirements of *NSF/ANSI 347 – Sustainability Assessment for Single Ply Roofing Membranes*. Minimum certification level established for this project is: *Platinum*.
- E. Use only a Manufacturer who has initiated a post consumer recycling program and can demonstrate a minimum of five projects where the existing PVC membrane has been removed and recycled into new roofing membrane or PVC components.
- F. Membrane Manufacturer must have *Recycled Content Certification* from UL (Underwriters Laboratories) Environment.
- G. Membrane thickness stated in this document refers to waterproofing membrane PVC polymer thickness. Polyester felt backing is always in addition to the required membrane thickness and is measured in weight per square yard. The required weight for felt backing is nine ounces per square yard (9-Oz./Yd<sup>2</sup>). This is a non-negotiable minimum requirement.
- H. Unreinforced or polyester reinforced membranes are prohibited.
- I. Re-labeled / re-packaged ("Private-labeled") primary and flashing membranes will not be accepted.

- J. Membrane Manufacturer must have ISO 14001 Certification and a Responsible Care Program in-place with current good standing status.
- K. Membrane Manufacturer must not require the use of membrane cut edge sealant at any location. This is a maintenance item that the Owner does not accept.
- L. The Manufacturer shall provide interim and final roof inspection from a directly employed dedicated team of experienced inspectors. Sales personnel may not be used for onsite inspection of installations.

### 1.3 PRE-INSTALLATION MEETING

- A. Arrange for a Pre-Installation Meeting between the Applicator, Owner's Representative, Roofing Manufacturer's Representative, and related trades to be held at least two (2) weeks prior to the beginning of roof system installation.
- B. Review contract documents, manufacturer's instructions, project conditions, and proposed methods and procedures related to installation.
  - 1. Identify conditions that would be detrimental to proper installation.
  - 2. Review special details, corner conditions, drainage patterns, penetrations and similar conditions of adjacent construction that will affect or impact surface preparation and installation operations.
  - 3. Review substrates and surfaces to receive materials in order to verify compliance with specified requirements, and with manufacturer's substrate tolerance recommendations and surface preparation requirements, including flatness, levelness, damage and imperfections, and quality of attachment to structure.
  - 4. Review limitations of floor and roof decks for structural loading both during and after installation.
- C. Review governing regulations and specified requirements for certificates, inspection, reports and closeout submittals.
- D. Review sequence of installation, finalize construction schedule, and verify availability of materials, installer's personnel, equipment and facilities necessary to make progress and avoid delays.
- E. Review temporary protection procedures required to be followed to provide protection of stored and installed products and accessories both during and after installation.
- F. Owner's Representative shall record significant meeting discussions, agreements and disagreements, including required corrective measures and actions to be taken before work begins. Distribute copy of minutes to Owner's Authorized Representative, to each party present, and to parties who should have been present no later than 3 business days following the meeting.

- G. Do not proceed with installation until all attendees, including all parties who should have been present, provide written acknowledgement of receipt and agreement to the conditions and requirements as described in the "Meeting Minutes". If disagreements cannot be successfully resolved, initiate necessary actions to remove impediments to execution of the Work and reconvene meeting at earliest available date to resolve outstanding disagreements.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- C. The applicator shall submit evidence that the proposed roof system meets local building code requirements and has been tested and approved or listed by the following test organizations.

- 1. ASCE/SEI 7 and SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems".

- a. Corner Design Uplift Pressure: 150 lbs. / Ft<sup>2</sup>
- b. Perimeter Design Uplift Pressure: 100 lbs. / Ft<sup>2</sup>
- c. Field-of-Roof Design Uplift Pressure: 60 lbs. / Ft<sup>2</sup>
- d. Safety Factor 2.0

- 2. Underwriters Laboratories, Inc.: Class A assembly

- D. Energy Performance:

Low-Slope Roofs: Provide roof system with an initial Solar Reflectance Index (SRI) of not less than 100 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency. Roof membrane (not post installation applied finish) shall comply with current California Title 24 Part 6 minimum 3-year aged solar reflectance of 0.63 and a minimum thermal emittance of 0.75 requirements.

#### 1.5 SUBMITTALS:

- A. Submittals upon contract award (utilizing the base specified system: Sika Sarnafil)
  - 1. A list of each primary component to be used in the roof system and the Manufacturer's current literature for each component including product data and safety data sheets.
  - 2. Sample copy of Roofing Manufacturer's warranty.
  - 3. Sample copy of Contractor's warranty.
  - 4. Letter from Roofing Manufacturer confirming that the Contractor is an authorized applicator of the specified roof system.

5. Letter from Roofing Contractor acknowledging all installation details will be installed as indicated. Any deviations must include a shop drawing approved by the Architect prior to installation.

B. Submittals of equals (prior to bid date)

Submit proposed equals to be considered for use on this project no less than fifteen (15) days prior to bid date. Proposed roof systems which have been reviewed and accepted will be listed in an addendum prior to bid date; only then will roof systems be accepted at bidding. All below referenced letters must be original, wet-ink signed by the proposed Roofing Manufacturer's Technical Director/Manager. Submittals shall include the following:

1. Two 12 inch x 12 inch membrane samples and two samples of each component to be used in the roofing system.
2. Manufacturer's specification matching the herein specified requirements for all Sub-Sections as described. The Manufacturer shall also provide written confirmation that all detail and flashing conditions will be installed in strict accordance with the OWNER'S Standards as indicated within this specification and otherwise stated within the Contract Documents. Acceptance of any other, non-specified manufacturer's material(s) will not be deemed as acceptance for use of said manufacturer's minimum detail and/or installation requirements.
3. Letter from the proposed Roofing Manufacturer stating that the Manufacturer has a minimum of 20 years consistent experience in directly producing the proposed roof system. The letter shall also state that the proposed Manufacturer's membrane has maintained a consistent formulation for a minimum of 20 years.
4. Letter from the Cool Roof Rating Council (CRRC) stating that the proposed PVC membrane demonstrates the required Solar Reflectance Index requirements as stated in Section 1.4 D above. Submit listing as an approved product by the CRRC.
5. Letter from proposed Roofing Manufacturer describing the specified certified polymer thickness program. Included shall be a sample copy of the proposed Manufacturer's certificate for polymer thickness as specified.
6. Letter from the proposed Roofing Manufacturer confirming that it has been engaged in a post-consumer recycling program in compliance with the requirements as started in Section 1.2 E above. The proposed Roofing Manufacturer shall provide written proof that its post-consumer recycling program has achieved *UL Environmental* certification.
7. Complete list of material physical and mechanical properties for each membrane and component including; weights and thicknesses; ultimate elongation; puncture resistance; seam peel strength; breaking strength; tear strength; dimensional stability; low temperature bend; and post-consumer recycle content.
8. Sample copy of specified warranties.



- a. Manufacturer's 20-Year System Warranty (with no ponding/standing water exclusions).
  - b. Contractor's Two (2) Year Warranty
9. Letter from the proposed Roofing Manufacturer confirming that the Contractor is an authorized applicator of the proposed roof system per the requirements of Section 1.2 B listed above.

#### 1.6 PRODUCT DELIVERY, STORAGE, and HANDLING:

All products delivered to the job-site shall be in the original unopened containers or wrappings bearing all seals and approvals. Handle all materials to prevent damage. Place all materials on pallets and fully protect from moisture.

#### 1.7 JOB CONDITIONS

- A. PVC materials may be installed under certain adverse weather conditions but only after consultation with the Roofing Manufacturer, as installation time and system integrity may be affected.
- B. Uninterrupted waterstops shall be installed at the end of each day's work and shall be completely removed before proceeding with the next day's work.
- C. Arrange work sequence to avoid use of newly constructed roofing as a walking surface or for equipment movement and storage. Where such access is absolutely required, the General Contractor shall provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent areas. A substantial protection layer consisting of 1/2" plywood over polyester felt or 1/2" plywood over insulation board shall be provided for all new and existing roof areas which receive rooftop traffic during construction.
- D. The Applicator shall verify that all roof and integral gutter drain lines are functioning correctly (not clogged or blocked) before starting work. Applicator shall report any such blockages to the Owner's Representative for corrective action prior to beginning roof system installation.

#### 1.8 BIDDING REQUIREMENTS

##### A. Bidders Responsibility

Bidders must have held their Roofing Contractors License (C39) for a minimum of five (5) years, with a continuous "Good-Standing" status to qualify to bid on this project. Any discrepancy between measurements and conditions listed within this specification, roof plans, and details, and those actually incurred on the job will be the responsibility of the Applicator.

#### 1.9 WARRANTIES

##### A. Roofing Manufacturer's 20-Year Full System Warranty: 60 MPH Windspeed Coverage

Upon successful completion of all the work to the Roofing Manufacturer's and Owner's Representative's satisfaction, the 20 Year Full System Warranty shall be issued. The System warranty shall provide Non-Penal Sum (replacement cost) coverage for the roof membrane, all

associated accessories that comprise the roof system, and all contractor labor for 20 years. The warranty shall be non-prorated, and shall not exclude ponding/standing water and no time limit shall be assigned for any such ponding/standing water during the warranty term. The warranty shall not exclude regular foot traffic on the roof membrane surface. Warranty shall not obligate the Owner to perform manufacturer defined maintenance work as a condition of continued warranty coverage.

B. Roofing Applicator/Contractor Two (2) Year Warranty

The Applicator/Contractor shall supply the Owner with a separate two year workmanship warranty. In the event any work related to roofing, flashing, or metal is found to be within the Applicator/Contractor warranty term, defective or otherwise not in accordance with the Contract Documents, the Applicator/Contractor shall repair that defect at no cost to the Owner.

- C. "Early Bird" warranties are not to be issued as they will not be accepted by the Owner. The above specified Warranty will be issued only upon acceptance by the Roofing Manufacturer's Technical Department and the Owner's Representative's final approval.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. The components of the adhered PVC feltback membrane roof system are to be products of Sika Sarnafil and/or products utilized by Sika Sarnafil to designate type, quality, and performance standards for this project.
- B. Substitutions: Upon pre-approval in accordance with Section 1.5 B above and listed as approved by addenda.

### 2.2 MANUFACTURER AND MEMBRANE

- A. Sika Sarnafil: G410 60-mil Guaranteed Minimum Thickness PVC with 9 oz. integral felt backing (Western Region Contact:(909) 942-0079).
- B. G410-60: Fiberglass reinforced membrane with an integral lacquer coating to repel dirt and sustain long-term solar reflectivity.
- C. Membrane shall be manufactured by Extrusion/Spread Coating process only, producing a monolithic membrane with fully encapsulated fiberglass reinforcement layer and a minimum of 27-mils of "weathering" polymer above the fiberglass reinforcement layer.
- D. Membrane shall conform to ASTM D4434 (latest revision), "Standard for Polyvinyl Chloride Sheet Roofing". Classification: Type II Grade I (fiberglass reinforcement).
- E. Roofing Manufacturer shall certify in writing that the product supplied for this project has a minimum polymer thickness of 60 mils. ASTM +/- tolerance for membrane thickness is not accepted.

F. Membrane shall comply with California Building Code (CBC) Title 24, Section 118 requirements for solar reflectivity and emissivity. Manufacturer and membrane shall be listed in the Cool Roof Rating Council (CRRC) product listing as outlined by the Department of Energy (DOE) and the Environmental Protection Agency (EPA).

G. As manufactured, membrane shall conform to the following physical properties:

1. Color to be “EnergySmart” Tan.
2. Thickness to be 60-mil (1.50 mm).

Property	ASTM Test Method	Minimum Physical Properties Requirements
Overall Thickness, mil	D751	60
Thickness Over Scrim, mil	--	27
Reinforcing Material	--	Fiberglass
Felt Weight, oz/yd <sup>2</sup> (feltback membrane only)	--	9
Breaking Strength, lbf/in (N)	D751	80 (356)
Elongation at Break, % M.D.(1) & C.M.D. (1)	D751	250 & 220
Seam Strength, % of original (2)	D751	Pass
Retention of Properties After Heat Aging	D3045	--
Breaking Strength, % of original	D751	Pass
Elongation, % of original	D751	Pass
Tearing Resistance, lbf (N)	D1004	17.5 (78)
Low Temperature Bend, -40F(-40C)	D2136	Pass
Accelerated Weather Test (Florescent Light UV Exposure),Hours	G154	10,000
Cracking (7x magnification)		None
Discoloration (by observation)		Negligible
Crazing (7x magnification)		None
Linear Dimensional Change, %	D1204	-0.02
Weight Change After Immersion in Water, %	D570	1.9
Static Puncture Resistance, lbf (kg)	D5602	Pass
Dynamic Puncture Resistance, ft-lbf (J)	D5635	Pass

Recycle Content

9% Pre-consume, 1% Post-consumer

\*Results may differ based upon statistical variations depending upon mixing methods and equipment, temperature, application methods, test methods, actual site conditions, and curing conditions.

(1) M.D. = Machine Direction, C.M.D. = Cross Machine Direction

(2) Failure occurs through membrane rupture not seam failure.

## 2.3 FLASHING MATERIALS

### A. Wall/Curb Flashing

1. G410 Membrane: Fiberglass reinforced membrane adhered to approved substrate using Stabond adhesive. Consult Sarnafil Product Data Sheets for additional information.
2. S327 Membrane: Polyester reinforced membrane for mechanically-attached flashings to approved substrate using Sarnastop.
3. Sarnaclad: PVC-coated, heat-weldable sheet metal. Sarnaclad is a 25 gauge, G90 galvanized metal sheet with a 20 mil (1 mm) unsupported PVC membrane laminated on one side. Consult Sarnafil Product Data Sheet for additional information.

B. Perimeter Flashing:

1. PVC Clad Metal Edge: PVC coated, heat-weldable sheet metal with continuous 22-gauge galvanized metal cleat. Sarnaclad is a 24 gauge, G90 galvanized metal sheet with a 20 mil (1 mm) unsupported PVC membrane laminated on one side.

C. Miscellaneous Flashing;

1. Aluminum Membrane Attachment Bar (Sarnastop)
2. Termination Reglet (Sarnareglet)
3. Pipe Boots (Sarnastack)
4. Universal Corners (Sarnacorners)
5. Flashing Membrane Adhesive (Stabond)

## 2.4 COVER BOARD

- A. Georgia-Pacific DensDeck® Prime with EONIC Technology Cover Board or pre-approved equal: Impact and mold resistant, gypsum core fire barrier board with pre-coated glass-mat facers. Manufactured to meet the following requirements:

1. Acceptable Product: GP Gypsum, DensDeck® Prime Roof Boards.
2. Thickness: 1/4 inch.
3. Width: 4 feet.
4. Length: 8 feet.
5. Weight: 1.2 lb/sq. ft.
6. Surfacing: Primed Fiberglass Mat.
7. Flexural Strength, Parallel (ASTM C473): 40 lbf, minimum.
8. Flute Span (ASTM E661): 2-5/8 inches.
9. Permeance (ASTM E96): Greater than 30 perms.
10. R-Value (ASTM C518): 0.28.
11. Water Absorption (ASTM C473): Less than 5 percent of weight.
12. Surface Water Absorption (ASTM C473): Nominal 1.0 grams.
13. Compressive Strength (Applicable Sections of ASTM C472): Nominal 900 pounds per square inch.
14. Flame Spread/ Smoke Development (ASTM E84): Not more than 0 Flame Spread, 0 Smoke Development
15. Combustibility (ASTM E136): Noncombustible
16. Fire resistance rating (UL 790 and ASTM E108): Class A
17. Mold Resistance (ASTM D3273): Scored a 10

- B. Tapered Insulation (Crickets Only): 1/2" min. x 4' x 4' sloped rigid roof insulation panels composed of polyisocyanurate closed-cell foam core with coated glass facer laminated to both sides. Manufactured to meet the following requirements:
  - 1. ASTM C1289-11, Type II, Class 2, Grade 2 (20 psi)
  - 2. Zero Ozone Depletion Potential (ODP) from blowing agent (HCFC-free).
  - 3. Long-Term Thermal Resistance (LTTR) R-Value based on ASTM 1303-11 and/or CAN/ULC-S770-09: Regardless of published values.
  - 4. Facer Type: Premium performance coated glass facer.
  - 5. Board Size: 1/2" min. x 4' x 4'.
  - 6. Tapered Insulation Slope: 1/2" per foot (double the primary slope) or as indicated otherwise.

## 2.5 ATTACHMENT COMPONENTS

- A. Membrane Adhesive, V.O.C. Compliant Water Based Adhesive (Sarnacol 2121 Adhesive): Water-based adhesive used to attach the membrane to the horizontal or near-horizontal substrate. Consult Product Data Sheets for additional information.
- B. Sarnafastener #12: Corrosion-resistant #12 fastener used with attachment plate to attach cover board to wood roof deck.
- C. Sarnaplate: Used with Sarnafasteners to attach cover board to roof deck. Sarnaplate is a 3 inch square or round, 26 gauge stamping of SAE 1010 steel with an AZ 55 Galvalume coating.
- D. Flashing Membrane Adhesive (Stabond Adhesive): Solvent-based reactivating-type adhesive used to attach the membrane to the flashing substrate. Consult Product Data Sheets for additional information.
- E. Sarnafastener-XP: Corrosion-resistant #15 fastener used with membrane attachment bar to attach membrane to wood roof deck or curbed penetrations.
- F. Membrane Attachment Bar (Sarnastop): One (1) inch wide, pre-punched aluminum membrane attachment bar. Used to attach PVC membrane at all perimeter and base-angle transitions. Consult Sarnafil Product Data Sheet for additional information.

## 2.6 WALKWAY PROTECTION

- A. Equipment Access/Walkway Tread (Sikaplan Walkway-20): Polyester reinforced, 79 mil, weldable membrane with surface embossment. Used as a protection layer from rooftop traffic. Sikaplan Walkway-20 is supplied in rolls of 3.25 feet wide and 32.67 feet long. Consult Sarnafil Product Data Sheet for additional information.

## 2.7 MISCELLANEOUS ACCESSORIES

- A. Sealing Tape: Compressible foam with pressure-sensitive adhesive on one side. Used with metal flashings as a preventive measure against air and wind blown moisture entry.
- B. Sarnasolv: Solvent cleaner used for the general cleaning of scuff marks, etc., from the Membrane surface.

## 2.8 SEALANTS

- A. Depending on substrates, the following sealants are options for temporary overnight tie-ins:
  - 1. Multiple layers of roofing cement and felt.
  - 2. Mechanical attachment with rigid bars and compressed sealant.

## 2.9 EQUIPMENT / PIPING SUPPORTS

- A. Miro Industries, Inc.: Pillow Block or Strut Series piping supports installed over protection membrane to support roof top equipment or piping and protect new PVC Roof System.

## 2.10 MISCELLANEOUS FASTENERS AND ANCHORS:

- A. All fasteners, anchors, nails, straps, bars, etc. shall be post-galvanized steel, aluminum or stainless steel. Mixing metal types and methods of contact shall be assembled in such a manner as to avoid galvanic corrosion. Fasteners for attachment of metal to masonry shall be expansion type fasteners with stainless steel pins. All concrete fasteners and anchors must have a minimum embedment of 1-1/4 inch and must be approved by the fastener manufacturer. All miscellaneous wood fasteners and anchors used for flashings must have a minimum embedment of 1 inch and shall be approved by fastener manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION:

Report to Owner's Representative in writing all conditions that interfere with or prevent correct installation of work of this Section.

### 3.2 PRE-INSTALLATION MEETING

- A. Refer to Section 1.3 of this specification for meeting agenda requirements.

Discuss the following additional project aspects:

- 1. Safety
- 2. Set up
- 3. Construction schedule
- 4. Contract conditions
- 5. Coordination of the work
- 6. Structural Loading Limitations/Requirements

## 7. Review of Deck and/or Substrate Conditions

### 3.3 SUBSTRATE CONDITION

- A. Applicator shall be responsible for acceptance or provision of proper substrate to receive new roofing materials.
- B. Applicator shall verify that the work done under related sections meets the following conditions:
  - 1. Roof drains and/or scuppers have been installed and/or are functioning properly.
  - 2. Roof curbs, equipment supports, vents and other roof penetrations are properly secured and prepared to receive new roofing materials.
  - 3. All surfaces are smooth and free of dirt, debris and incompatible materials.
  - 4. All roof surfaces shall be free of water.

### 3.4 SUBSTRATE PREPARATION

The roof deck and existing roof construction must be structurally sound to provide support for the new roof system. The Applicator shall load materials on the rooftop in such a manner to eliminate risk of deck overload due to concentrated weight. The Owner's Representative shall ensure that the roof deck is secured to the structural framing according to local building code and in such a manner as to resist all anticipated wind loads in that location.

### 3.5 SUBSTRATE INSPECTION

- A. A dry, clean and smooth substrate shall be prepared to receive the new PVC membrane roof system.
- B. The Applicator shall inspect the substrate for defects such as excessive surface roughness, contamination, structural inadequacy, or any other condition that will adversely affect the quality of work.
- C. The substrate shall be clean, smooth, dry, free of flaws, sharp edges, loose and foreign material, oil and grease. Roofing shall not start until all defects have been corrected.
- D. All roof surfaces shall be free of water.
- E. PVC membrane shall be applied over compatible and accepted substrates only.

### 3.6 COVER BOARD INSTALLATION

- A. Cover board shall be fastened to the wood deck with manufacturer approved plate and heavy duty fastener at a rate according to ASCE 7, Factory Mutual Class 1-90 and the Roofing Manufacturer's requirements for attachment rates and patterns.

### 3.7 INSTALLATION OF PVC ROOF MEMBRANE:

#### A. General

1. Roof membrane is to be adhered according to the Roofing Manufacturer and Factory Mutual's requirements.
2. Membrane overlaps shall be shingled with the flow of water where possible.
3. Lay membrane rolls perpendicular to the direction of the roof slope.
4. Tack welding of membrane full or half-width rolls for purposes of temporary restraint during installation on windy days is not permitted. Consult Roofing Manufacturer's Technical Department for further information.
5. Hot-air weld overlaps according to roofing manufacturer's Take test cuts at least 3 times per day.
6. Membrane flashings shall extend 2-1/2 inches past the membrane attachment bar and shall be hot-air welded to the field membrane as required.

NOTE: For buildings that are occupied during construction, all adhesive application shall occur during off hours or during non-school days. All HVAC equipment shall be turned off and air intakes sealed to not allow adhesive fumes into building.

### 3.8 HOT-AIR WELDING OF SEAM OVERLAPS :

- A. All field seams shall be hot-air welded using robotic welding equipment only (no hand-held welders). Seam overlaps should be 3 inches wide except for certain details.

### 3.9 MEMBRANE FLASHINGS:

- A. All flashings shall be installed concurrently with the roof membrane as the job progresses.
- B. Stabond Adhesive for Membrane Flashings: Stabond adhesive shall be applied according to instruction found on the Product Data Sheets. The bonded sheet shall be pressed firmly in place with a hand roller.

NOTE: For buildings that are occupied during construction, all adhesive application shall occur during off hours or during non-school days. All HVAC equipment shall be turned off and air intakes sealed to not allow adhesive fumes into building.

- C. All flashings shall extend a minimum of eight (8) inches above roofing level unless otherwise accepted in writing. No bitumen shall be in contact with the PVC membrane. All flashing membranes shall be mechanically fastened along the counter-flashed top edge with Sarnastop or Sarnareglet at six inches (6") on-center.

### 3.10 PVC CLAD METAL BASE FLASHINGS:

- A. All metal flashings shall be fastened into metal stud nailers or metal stud backing plates with manufacturer approved fasteners. Fasteners shall penetrate the nailer a minimum of 1 inch. Metal shall be installed to provide adequate resistance to bending and allow for normal thermal expansion and contraction.



- B. Adjacent sheets of PVC clad metal shall be spaced 1/4 inch apart. The joint shall be covered with two (2) inch wide aluminum tape. A four (4) inch minimum wide strip of PVC flashing membrane shall be hot-air welded over the joint.

### 3.11 METAL FLASHINGS

- A. Metal details, fabrication practices and installation methods shall conform to the applicable requirements of the following:
  - 1. Factory Mutual Loss Prevention Data Sheet 1-49 (latest issue).
  - 2. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) – latest issue.
- B. Metal joints shall be watertight. Metal flashings shall be securely fastened into metal stud backing plates. Fasteners shall penetrate the metal studs. Counter flashings shall overlap base flashings at least four (4) inches. Hook strips shall extend past metal studs and shall be securely sealed from air entry.

### 3.12 PIPE SUPPORTS

- A. Install Miro Industries Pillow Block or Strut Series supports in accordance with International Mechanical Code – Section 305 Piping Support with maximum allowable horizontal spacing at 4 to 10 feet depending on pipe type and size.

### 3.13 WALKWAY INSTALLATION

- A. Sikaplan Walkway-20: Apply a continuous coat of Stabond adhesive to the deck sheet and the back of Walkway in accordance with Sika Sarnafil's Technical requirements and press Walkway into place with a water-filled, foam-covered roller. Hot-air weld the entire perimeter of the Walkway to the field membrane.

### 3.14 TEMPORARY CUT-OFF

- A. Flashings shall be installed concurrently with the roof membrane in order to maintain a watertight condition as the work progresses:
  - 1. Temporary waterstops shall be constructed to provide a 100% watertight seal.
  - 2. Stagger of the insulation joints shall be made even by installing partial panels of insulation.
  - 3. New membrane shall be carried into the waterstop sealant.
  - 4. Waterstop shall be sealed to the deck and/or substrate so that water will not be allowed to travel under the new or existing roofing.
  - 5. When work resumes, the contaminated membrane shall be cut out.
  - 6. Sealant, contaminated membrane, insulation fillers, etc. shall be removed from work area and properly disposed of offsite. These materials shall not be used in new work.
- B. If inclement weather occurs while temporary waterstop is in place, Applicator shall provide the labor necessary to monitor the situation to maintain a watertight condition.

- C. If water is allowed to enter under the newly-completed roofing, the affected area shall be removed and replaced at the Applicator's expense.

### 3.15 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Owner's Representative.
- B. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.

### 3.16 PROTECTION 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, provide written report, with copies to the Owner's Representative.
- 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 Contract Completion and according to warranty requirements.

END OF SECTION

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**SECTION 076200  
SHEET METAL FLASHING AND TRIM**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, and downspouts.
- B. Sealants for joints within sheet metal fabrications.

**1.02 REFERENCE STANDARDS**

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- C. ASTM B32 - Standard Specification for Solder Metal 2020.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- E. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free 2007 (Reapproved 2018).
- F. CDA A4050 - Copper in Architecture - Handbook current edition.
- G. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

**1.04 QUALITY ASSURANCE**

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
- B. Maintain one copy of each document on site.
- C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 3 years of documented experience.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

**PART 2 PRODUCTS**

**2.01 SHEET MATERIALS**

- A. General: Sheet metal flashing and trim assemblies to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239 inch) thick base metal.
- C. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239) inch thick base metal, shop pre-coated with PVDF coating.
  - 1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
  - 2. Color: As indicated on drawings.

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## 2.02 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- F. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

## 2.03 GUTTER AND DOWNSPOUT FABRICATION

- A. Gutters: SMACNA (ASMM) Rectangular profile.
- B. Downspouts: Rectangular profile.
- C. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM).
- D. Accessories: Profiled to suit gutters and downspouts.
  - 1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
  - 2. Gutter Supports: Brackets.
  - 3. Downspout Supports: Brackets.
- E. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.
- F. Downspout Boots: Steel.
- G. Downspout Extenders: Same material and finish as downspouts.
- H. Seal metal joints.

## 2.04 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Primer: Zinc chromate type.
- C. Concealed Sealants: Non-curing butyl sealant.
- D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- E. Plastic Cement: ASTM D4586/D4586M, Type I.
- F. Solder: ASTM B32; Sn50 (50/50) type.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

### 3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.
- C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

### 3.03 INSTALLATION

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- A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Solder metal joints for full metal surface contact, and after soldering wash metal clean with neutralizing solution and rinse with water.
- E. Secure gutters and downspouts in place with concealed fasteners.
- F. Slope gutters 1/4 inch per 10 feet, minimum.
- G. Connect downspouts to downspout boots, and grout connection watertight.

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

- A. See Section 014000 - Quality Requirements, for field inspection requirements.
- B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

**END OF SECTION**

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## SECTION 078400 FIRESTOPPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

#### 1.02 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).
- B. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems 2020a.
- C. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers 2020a.
- D. ITS (DIR) - Directory of Listed Products Current Edition.
- E. FM 4991 - Approval Standard of Firestop Contractors 2013.
- F. FM (AG) - FM Approval Guide current edition.
- G. UL (DIR) - Online Certifications Directory Current Edition.
- H. UL (FRD) - Fire Resistance Directory Current Edition.

#### 1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Installer Qualification: Submit qualification statements for installing mechanics.

#### 1.04 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
  - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
  - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at [www.icc-es.org](http://www.icc-es.org) will be considered as constituting an acceptable test report.
  - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
  - 1. Trained by manufacturer.
  - 2. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
  - 3. Verification of minimum three years documented experience installing work of this type.
  - 4. Verification of at least five satisfactorily completed projects of comparable size and type.
  - 5. Licensed by local authorities having jurisdiction (AHJ).

#### 1.05 FIELD CONDITIONS

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- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Firestopping Manufacturers:
  1. 3M Fire Protection Products: [www.3m.com/firestop/#sle](http://www.3m.com/firestop/#sle).
  2. A/D Fire Protection Systems Inc: [www.adfire.com/#sle](http://www.adfire.com/#sle).
  3. Hilti, Inc: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
  4. Nelson FireStop Products: [www.nelsonfirestop.com/#sle](http://www.nelsonfirestop.com/#sle).
  5. Specified Technologies Inc: [www.stifirestop.com/#sle](http://www.stifirestop.com/#sle).
  6. Tremco Commercial Sealants & Waterproofing; TREMstop Acrylic: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).

### **2.02 MATERIALS**

- A. Firestopping Materials: Any materials meeting requirements.
- B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- C. Fire Ratings: Refer to drawings for required systems and ratings.

### **2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS**

- A. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
  1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
  2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
  3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
  4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

### **2.04 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS**

- A. Blank Openings:
  1. 1 Hour Construction: UL System W-L-0032; Specified Technologies Inc. FP Intumescent Firestop Plug.
  2. 1 Hour Construction: UL System W-L-0038; Specified Technologies Inc. FP Intumescent Firestop Plug.
  3. 1 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
- B. Penetrations By:
  1. Multiple Penetrations in Large Openings:
    - a. 1 Hour Construction: UL System W-L-1389; Hilti FS-ONE Intumescent Firestop Sealant.
    - b. 1 Hour Construction: UL System W-L-1408; Hilti FS-ONE MAX Intumescent Firestop Sealant.
    - c. 1 Hour Construction: UL System W-L-8013; Hilti CFS-BL Firestop Block.
    - d. 1 Hour Construction: UL System W-L-8025; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
    - e. 1 Hour Construction: UL System W-L-8050; Specified Technologies Inc. SSB Intumescent Firestop pillows.
    - f. 1 Hour Construction: UL System W-L-8071; Hilti FS-ONE MAX Intumescent Firestop Sealant.
    - g. 1 Hour Construction: UL System W-L-8073; Specified Technologies Inc. Composite Sheet.

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- h. 1 Hour Construction: UL System W-L-8079; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- 2. Uninsulated Metallic Pipe, Conduit, and Tubing:
  - a. 1 Hour Construction: UL System W-L-1042; Specified Technologies Inc. WF300 Intumescent Firestop Caulk (for wood frame construction).
  - b. 1 Hour Construction: UL System W-L-1049; Specified Technologies Inc. SSS Intumescent Firestop Sealant.
  - c. 1 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - d. 1 Hour Construction: UL System W-L-1090; Specified Technologies Inc. LC Endothermic Firestop Sealant.
  - e. 1 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - f. 1 Hour Construction: UL System W-L-1222; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
  - g. 1 Hour Construction: UL System W-L-1477; Specified Technologies Inc. EZ Firestop Grommet.
  - h. 1 Hour Construction: UL System W-L-1506; Hilti CFS-D Firestop Cable Disc.
  - i. 1 Hour Construction: UL System W-L-1206; Hilti FS-ONE Intumescent Firestop Sealant.
- 3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
  - a. 1 Hour Construction: UL System W-L-2048; Specified Technologies Inc. SSW wrap strips.
  - b. 1 Hour Construction: UL System W-L-2074; Specified Technologies Inc. SSC collars.
  - c. 1 Hour Construction: UL System W-L-2078; Hilti CP 643N/644 Firestop Collar.
  - d. 1 Hour Construction: UL System W-L-2411; Hilti CP 648-E Firestop Wrap Strip.
  - e. 1 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - f. 1 Hour Construction: UL System W-L-2237; Specified Technologies Inc. LCC Intumescent Firestop Collars.
  - g. 1 Hour Construction: UL System W-L-2241; Specified Technologies Inc. WF300 Intumescent Firestop Caulk (for wood frame construction).
  - h. 1 Hour Construction: UL System W-L-2243; Specified Technologies Inc. SSW wrap strips.
  - i. 1 Hour Construction: UL System W-L-2493; Specified Technologies Inc. RTC range-taking collar.

## 2.05 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
  - 1. Fire Ratings: Use system that is listed by FM (AG) and tested in accordance with ASTM E814 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

### 3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.

### 3.03 INSTALLATION



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- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by Owner's Independent Testing Agency.
- C. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- D. Install labeling required by code.

**3.04 FIELD QUALITY CONTROL**

- A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174, and ASTM E2393.
- B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

**3.05 CLEANING**

- A. Clean adjacent surfaces of firestopping materials.

**3.06 PROTECTION**

- A. Protect adjacent surfaces from damage by material installation.

**END OF SECTION**

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**SECTION 079200  
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 REFERENCE STANDARDS**

- A. ASTM C834 - Standard Specification for Latex Sealants 2017.
- B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- C. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
- D. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants 2018.
- E. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness 2015 (Reapproved 2021).
- F. SCAQMD 1168 - Adhesive and Sealant Applications 1989, with Amendment (2017).

**1.03 SUBMITTALS**

- A. See Section 013000 - 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. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.
- F. Installation Plan: Submit at least four weeks prior to start of installation.
- G. Installation Log: Submit filled out log for each length or instance of sealant installed.

**1.04 QUALITY ASSURANCE**

- A. Maintain one copy of each referenced document covering installation requirements on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
- D. Installation Plan: Include schedule of sealed joints, including the following.
  - 1. Joint width indicated in contract documents.
  - 2. Joint depth indicated in contract documents; to face of backing material at centerline of joint.

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3. Method to be used to protect adjacent surfaces from sealant droppings and smears, with acknowledgement that some surfaces cannot be cleaned to like-new condition and therefore prevention is imperative.
4. Installation Log Form: Include the following data fields, with known information filled out.
  - a. Date of installation.
  - b. Name of installer.
  - c. Actual joint width; provide space to indicate maximum and minimum width.
  - d. Actual joint depth to face of backing material at centerline of joint.
  - e. Air temperature.

### 1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- 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 MANUFACTURERS

- A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
  1. Adhesives Technology Corporation: [www.atcepoxy.com/#sle](http://www.atcepoxy.com/#sle).
  2. Bostik Inc: [www.bostik-us.com/#sle](http://www.bostik-us.com/#sle).
  3. Dow Chemical Company: [consumer.dow.com/en-us/industry/ind-building-construction.html/#sle](http://consumer.dow.com/en-us/industry/ind-building-construction.html/#sle).
  4. Fortifiber Building Systems Group: [www.fortifiber.com/#sle](http://www.fortifiber.com/#sle).
  5. Franklin International, Inc: [www.titebond.com/#sle](http://www.titebond.com/#sle).
  6. Hilti, Inc: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
  7. Master Builders Solutions by BASF: [www.master-builders-solutions.basf.us/en-us/#sle](http://www.master-builders-solutions.basf.us/en-us/#sle).
  8. Momentive Performance Materials, Inc (formerly GE Silicones): [www.momentive.com/#sle](http://www.momentive.com/#sle).
  9. Pecora Corporation: [www.pecora.com/#sle](http://www.pecora.com/#sle).
  10. QUIKRETE Companies: [www.quikrete.com/#sle](http://www.quikrete.com/#sle).
  11. Sherwin-Williams Company: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
  12. Sika Corporation: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
  13. Specified Technologies Inc: [www.stifirestop.com/#sle](http://www.stifirestop.com/#sle).
  14. Tremco Commercial Sealants & Waterproofing: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
  15. W.R. Meadows, Inc: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
- B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
  1. Adhesives Technology Corporation: [www.atcepoxy.com/#sle](http://www.atcepoxy.com/#sle).
  2. Bostik Inc: [www.bostik-us.com/#sle](http://www.bostik-us.com/#sle).
  3. Dayton Superior Corporation: [www.daytonsuperior.com/#sle](http://www.daytonsuperior.com/#sle).
  4. Dow Chemical Company: [consumer.dow.com/en-us/industry/ind-building-construction.html/#sle](http://consumer.dow.com/en-us/industry/ind-building-construction.html/#sle).
  5. Master Builders Solutions by BASF: [www.master-builders-solutions.basf.us/en-us/#sle](http://www.master-builders-solutions.basf.us/en-us/#sle).
  6. Pecora Corporation: [www.pecora.com/#sle](http://www.pecora.com/#sle).
  7. QUIKRETE Companies: [www.quikrete.com/#sle](http://www.quikrete.com/#sle).
  8. Sherwin-Williams Company: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
  9. Sika Corporation: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
  10. Tremco Commercial Sealants & Waterproofing: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
  11. W.R. Meadows, Inc: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).

### 2.02 JOINT SEALANT APPLICATIONS

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- A. Scope:
1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
    - a. Wall expansion and control joints.
    - b. Joints between door, window, and other frames and adjacent construction.
    - c. Joints between different exposed materials.
    - d. Other joints indicated below.
  2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
    - a. Joints between door, window, and other frames and adjacent construction.
    - b. Other joints indicated below.
  3. Do not seal the following types of joints.
    - a. Intentional weepholes in masonry.
    - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
    - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
    - d. Joints where installation of sealant is specified in another section.
    - e. Joints between suspended panel ceilings/grid and walls.
- B. Type 1- Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
1. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.
- C. Type 2- Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
1. Type 2A- Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
  2. Type 2B- Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion.
  3. Type 2C- Floor Joints in Wet Areas: Non-sag polyurethane "non-traffic-grade" sealant suitable for continuous liquid immersion.
  4. Type 2D- Wall, Ceiling, and Floor Joints Where Tamper-Resistance is Required: Non-sag tamper-resistant silyl-terminated polyurethane sealant.
  5. Type 2E- Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
  6. Type 2F- Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant.
  7. Type 2G- Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.
- D. Interior Wet Areas: Bathrooms and restrooms; fixtures in wet areas include plumbing fixtures, countertops, and cabinets.
- E. Areas Where Tamper-Resistance is Required: As indicated on drawings.

### 2.03 JOINT SEALANTS - GENERAL

- A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

### 2.04 NONSAG JOINT SEALANTS

- A. Type A- Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
  2. Color: Match adjacent finished surfaces.
  3. Manufacturers:
    - a. Dow Chemical Company; DOWSIL 756 SMS Building Sealant: [consumer.dow.com/en-us/industry/ind-building-construction.html/#sle](http://consumer.dow.com/en-us/industry/ind-building-construction.html/#sle).
    - b. Dow Chemical Company; DOWSIL 790 Silicone Building Sealant: [consumer.dow.com/en-us/industry/ind-building-construction.html/#sle](http://consumer.dow.com/en-us/industry/ind-building-construction.html/#sle).

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- c. Dow Chemical Company; DOWSIL 791 Silicone Weatherproofing Sealant: [consumer.dow.com/en-us/industry/ind-building-construction.html/#sle](http://consumer.dow.com/en-us/industry/ind-building-construction.html/#sle).
  - d. Dow Chemical Company; DOWSIL 795 Silicone Building Sealant: [consumer.dow.com/en-us/industry/ind-building-construction.html/#sle](http://consumer.dow.com/en-us/industry/ind-building-construction.html/#sle).
  - e. Sika Corporation; Sikasil WS-290: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
  - f. Sika Corporation; Sikasil WS-295: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
  - g. Sika Corporation; Sikasil 728NS: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
  - h. Tremco Commercial Sealants & Waterproofing; Spectrem 1: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
  - i. Tremco Commercial Sealants & Waterproofing; Spectrem 2: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
  - j. Tremco Commercial Sealants & Waterproofing; Spectrem 3: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
  - k. Tremco Commercial Sealants & Waterproofing; Spectrem 4-TS: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
  - l. Tremco Commercial Sealants & Waterproofing; Tremsil 200: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
  - m. Tremco Commercial Sealants & Waterproofing; Tremsil 400: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
- B. Type B- Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
- 1. Movement Capability: Plus and minus 25 percent, minimum.
  - 2. Color: Match adjacent finished surfaces.
  - 3. Manufacturers:
    - a. Fortifiber Building Systems Group; Moistop Sealant: [www.fortifiber.com/#sle](http://www.fortifiber.com/#sle).
    - b. Franklin International, Inc; Titebond 100% Silicone Sealant: [www.titebond.com/#sle](http://www.titebond.com/#sle).
    - c. Dow Chemical Company; DOWSIL 999-A Building and Glazing Sealant: [consumer.dow.com/en-us/industry/ind-building-construction.html/#sle](http://consumer.dow.com/en-us/industry/ind-building-construction.html/#sle).
    - d. Sherwin-Williams Company; Silicone Rubber All Purpose Sealant: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
    - e. Sika Corporation; Sikasil GP: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
    - f. Sika Corporation; Sikasil WS-295: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
    - g. Sika Corporation; Sikasil N-Plus US: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
    - h. Sika Corporation; Sikasil 728NS: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
- C. Type C- Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
- 1. Color: White.
  - 2. Manufacturers:
    - a. Sika Corporation; Sikasil GP: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
- D. Type D- Tamper-Resistant, Silyl-Terminated Polyurethane (STPU) Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
- 1. Color: Match adjacent finished surfaces.
  - 2. Manufacturers:
    - a. Sika Corporation; SikaHyflex-150 LM: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
- E. Type E- Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
- 1. Color: Standard colors matching finished surfaces, Type OP (opaque).
  - 2. Manufacturers:
    - a. Franklin International, Inc; Titebond GREENchoice Acoustical Smoke & Sound Sealant: [www.titebond.com/#sle](http://www.titebond.com/#sle).
    - b. Hilti, Inc; CP 506 Smoke and Acoustical Sealant: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
    - c. Hilti, Inc; CP 572 Smoke and Acoustical Spray Sealant: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).

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- d. Sherwin-Williams Company; White Lightning 3006 Siliconized Acrylic Latex Caulk: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
- e. Sherwin-Williams Company; 850A Acrylic Latex Caulk: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
- f. Sherwin-Williams Company; 950A Siliconized Acrylic Latex Caulk: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
- g. Sherwin-Williams Company; Bolt Quickdry Siliconized Acrylic Latex Caulk: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
- h. Sherwin-Williams Company; Powerhouse Siliconized Acrylic Latex Sealant: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
- i. Specified Technologies Inc; Smoke N' Sound Acoustical Sealant: [www.stifirestop.com/#sle](http://www.stifirestop.com/#sle).
- j. Top Gun, a brand of PPG Architectural Coatings; Top Gun 200: [www.ppgpaints.com/#sle](http://www.ppgpaints.com/#sle).
- k. Tremco Commercial Sealants & Waterproofing; Tremflex 834: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
- l. Tremco Commercial Sealants & Waterproofing; Tremstop Smoke & Sound: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
- m. Tremco Commercial Sealants & Waterproofing; Tremstop Smoke & Sound Spray: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).

## 2.05 SELF-LEVELING SEALANTS

- A. Type F- Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
  - 1. Movement Capability: Plus and minus 25 percent, minimum.
  - 2. Color: To be selected by Architect from manufacturer's standard range.
  - 3. Manufacturers:
    - a. The QUIKRETE Companies; QUIKRETE® Polyurethane Self-Leveling Sealant: [www.quikrete.com/#sle](http://www.quikrete.com/#sle).
    - b. Sherwin-Williams Company; Stampede 1SL Polyurethane Sealant: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
    - c. Sherwin-Williams Company; Stampede 2SL Polyurethane Sealant: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
    - d. Sika Corporation; Sikaflex-1c SL: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
    - e. Sika Corporation; Sikaflex-2c SL: [www.usa-sika.com/#sle](http://www.usa-sika.com/#sle).
- B. Type G- Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
  - 1. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
  - 2. Color: Concrete gray.
  - 3. Joint Width, Minimum: 1/8 inch.
  - 4. Joint Width, Maximum: 1/4 inch.
  - 5. Joint Depth: Provide product suitable for joints from 1/8 inch to 2 inches in depth including space for backer rod.
  - 6. Manufacturers:
    - a. Dayton Superior Corporation: [www.daytonsuperior.com/#sle](http://www.daytonsuperior.com/#sle).
    - b. Euclid Chemical Company; EUCO 700: [www.euclidchemical.com/#sle](http://www.euclidchemical.com/#sle).
    - c. Nox-Crete; DynaFlex 502: [www.nox-crete.com/#sle](http://www.nox-crete.com/#sle).
    - d. W.R. Meadows, Inc; Rezi-Weld Flex: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).

## 2.06 ACCESSORIES

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- 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.
  - 1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
  - 2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
  - 3. Open Cell: 40 to 50 percent larger in diameter than joint width.
  - 4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
  - 5. Manufacturers:
    - a. Nomaco, Inc; HBR: [www.nomaco.com/#sle](http://www.nomaco.com/#sle).
- 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.
- E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

#### **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. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- D. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
  - 1. Width/depth ratio of 2:1.
  - 2. Neck dimension no greater than 1/3 of the joint width.
  - 3. Surface bond area on each side not less than 75 percent of joint width.
- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

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- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

**END OF SECTION**



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**SECTION 081113  
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. Thermally insulated hollow metal doors with frames.
- D. Hollow metal borrowed lites glazing frames.
- E. Accessories, including glazing, louvers, and matching panels.

**1.02 ABBREVIATIONS AND ACRONYMS**

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2018.
- C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames 2020.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2020.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- 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 2021a.
- 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 2018a.
- I. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames 2016.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- K. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames 2002.
- L. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames 2011.
- M. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames 2017.
- N. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames 2014.
- O. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.
- P. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames 2019.

**1.04 SUBMITTALS**

- A. See Section 013000 - 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.

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- D. Samples: Submit two samples of metal, 2 inch by 2 inch in size showing factory finishes, colors, and surface texture.

### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Manufacturer Qualifications: Provide hollow metal doors and frames from SDI Certified manufacturer: [www.steeldoor.org/sdicertified.php/#sle](http://www.steeldoor.org/sdicertified.php/#sle).
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- D. Maintain at project site copies of reference standards relating to installation of products specified.

### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
  1. Ceco Door, an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  2. Curries, an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  3. Fleming Door Products, an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  4. Mesker, dormakaba Group; FDJ Series Drywall Frames: [www.meskeropeningsgroup.com/#sle](http://www.meskeropeningsgroup.com/#sle).
  5. Republic Doors, an Allegion brand: [www.republicdoor.com/#sle](http://www.republicdoor.com/#sle).
  6. Steelcraft, an Allegion brand: [www.allegion.com/#sle](http://www.allegion.com/#sle).
  7. Technical Glass Products; SteelBuilt Window & Door Systems: [www.tgpamerica.com/#sle](http://www.tgpamerica.com/#sle).

### 2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
  1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
  2. Accessibility: Comply with ICC A117.1 and ADA Standards.
  3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
  4. Door Edge Profile: Manufacturers standard for application indicated.
  5. Typical Door Face Sheets: Flush.
  6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: 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 (galvanized) 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 NAAMM HMMA Custom Guidelines: Provide at least A25/ZF75 (galvanized) for interior applications, and at least A60/ZF180 (galvanized) or G60/Z180 (galvanized) for corrosive locations.

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- 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. Door Finish: Factory primed and field finished.
- B. Exterior Doors: Thermally insulated.
  - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 2 - Heavy-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 galvanized 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. Door Finish: Factory primed and field finished.

### 2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
- C. Exterior Door Frames: Full profile/continuously welded type.
  - 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvanized) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
  - 2. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
  - 3. Weatherstripping: Separate, see Section 087100.
- D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
  - 1. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 45 degree angle.
  - 2. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
  - 3. Frame Finish: Factory primed and field finished.
- E. Door Frames, Fire-Rated: Full profile/continuously welded type.
  - 1. Fire Rating: Same as door, labeled.
  - 2. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 45 degree angle.
  - 3. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
  - 4. Frame Finish: Factory primed and field finished.
- F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- H. Transom Bars: Fixed, of profile same as jamb and head.

### 2.05 FINISHES

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

### 2.06 ACCESSORIES

- A. Glazing: As specified in Section 088000, factory installed.

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## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

### **3.02 PREPARATION**

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.
- B. Coat inside of other frames with bituminous coating to a thickness of 1/16 inch.

### **3.03 INSTALLATION**

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Install door hardware as specified in Section 087100.
  - 1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.
- E. Comply with glazing installation requirements of Section 088000.
- F. Coordinate installation of electrical connections to electrical hardware items.

### **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.

**END OF SECTION**

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**SECTION 081116  
ALUMINUM DOORS AND FRAMES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Glazed aluminum doors.
- B. Aluminum frames.
- C. Glazing.

**1.02 REFERENCE STANDARDS**

- A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.
- B. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.
- F. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- G. ITS (DIR) - Directory of Listed Products Current Edition.
- H. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2022.
- I. UL (DIR) - Online Certifications Directory Current Edition.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's descriptive literature for each type of door; include information on fabrication methods.
- C. Shop Drawings: Include elevations of each opening type.
  - 1. Verify dimensions by field measurements before fabrication and indicate on shop drawings.
- D. Verification Samples: Actual pieces of products in each finish specified, not less than 6 inches square or 6 inches long for linear components. For finishes subject to color variation, include not less than two samples illustrating extreme range to be anticipated.
- E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than five years of documented experience.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver aluminum components in manufacturer's standard protective packaging, palletted, crated, or banded together.
- B. Inspect delivered components for damage and replace. Repaired components will not be accepted.
- C. Store components in clean, dry, indoor area, under cover in manufacturer's packaging until installation.
- D. Protect materials and finish from damage during handling and installation.

**1.06 FIELD CONDITIONS**

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- A. Do not begin installation of interior aluminum components until space has been enclosed and ambient thermal conditions are being maintained at levels consistent with final project requirements.

### 1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide ten year manufacturer warranty for defects in workmanship and materials.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Glazed Aluminum Doors:
- B. Aluminum Frames:
  1. Cline Aluminum Doors, Inc: [www.clinedoors.com/#sle](http://www.clinedoors.com/#sle).
  2. Wilson Partitions: [www.wilsonpart.com/#sle](http://www.wilsonpart.com/#sle).

### 2.02 DOORS AND FRAMES

- A. Accessibility: Comply with ICC A117.1 and ADA Standards.
- B. Glazed Aluminum Doors: Extruded aluminum tube frame, full glazed, with middle rail; factory glazed.
  1. Thickness: 1-3/4 inches, nominal.
  2. Stile Width: As indicated on drawings.
  3. Finish: Superior performing organic coating.
  4. Texture: Smooth.
  5. Glazing, Interior Doors: Clear, 1/4 inch thick fully tempered glass.
  6. Glazing: As specified in Section 088000.
- C. Aluminum Frames for Doors, Sidelights, or Transoms: Extruded aluminum, non-thermally broken hollow or C-shaped sections; no steel components.
  1. Frame Depth: To fit wall thicknesses as indicated on drawings.
  2. Frames for Fire-Rated Doors Specified Elsewhere: Tested in accordance with NFPA 252, listed and labeled by UL (DIR), ITS (DIR), or testing agency acceptable to authorities having jurisdiction.
  3. Finish: Same as doors.
  4. Sidelight/Transom Glazing: As specified in Section 088000.
- D. Dimensions and Shapes: As indicated on drawings; dimensions indicated are nominal.
  1. Provide vision lites as indicated on drawings.
  2. Provide the following clearances:
    - a. Hinge and Lock Stiles: 1/8 inch.
    - b. Between Meeting Stiles: 1/4 inch.
    - c. At Top Rail and Bottom Rail: 1/8 inch.

### 2.03 COMPONENTS

- A. Frames: Extruded aluminum shapes, not less than 0.062 inch thick, reinforced at hinge and strike locations.
  1. Corner Brackets: Extruded aluminum, fastened with stainless steel screws.
  2. Trim: Extruded aluminum, not less than 0.062 inch thick, removable snap-in type without exposed fasteners.
- B. Vision Lites: Extruded aluminum framed, gasket glazed.
- C. Door Hardware: Refer to Section 087100 for additional requirements.

### 2.04 MATERIALS

- A. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy 5005, temper H14, stretcher leveled.

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- B. Extruded Aluminum: ASTM B221 (ASTM B221M), alloy 6063, temper T5, or alloy 6463, temper T5.

## 2.05 FINISHES

- A. Superior Performing Organic Coatings: Multiple coats, thermally cured polyvinylidene fluoride (PVDF) system; AAMA 2605.
  - 1. Polyvinylidene fluoride (PVDF) multi-coat thermoplastic fluoropolymer coating system, with minimum 70 percent PVDF color topcoat and minimum dry film thickness 0.9 mil; color and gloss as indicated on drawings.
- B. Color: As indicated on drawings.

## 2.06 ACCESSORIES

- A. Fasteners: Aluminum, non-magnetic stainless steel, or other material warranted by manufacturer as non-corrosive and compatible with aluminum components.
- B. Brackets and Reinforcements: Manufacturer's high-strength aluminum units where feasible, otherwise, non-magnetic stainless steel or steel hot-dip galvanized in compliance with ASTM A123/A123M.
- C. Bituminous Coating: Cold-applied asphaltic mastic, compounded for 30-mil thickness per coat.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that wall surfaces and openings are ready to receive frames and are within tolerances specified in manufacturer's instructions.

### 3.02 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and approved shop drawings.
- B. Set frames plumb, square, level, and aligned to receive doors. Anchor frames to adjacent construction in strict accordance with manufacturer's recommendations and within specified tolerances.
- C. Where aluminum surfaces contact metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by painting dissimilar metal with heavy coating of bituminous paint.
- D. Hang doors and adjust hardware to achieve specified clearances and proper door operation.
- E. Install door hardware as specified in Section 087100.
- F. Install glazing; set glazing stops and glazing gaskets flush with face of door or frame.
- G. Comply with glazing installation requirements of Section 088000.

### 3.03 FIELD QUALITY CONTROL

- A. Provide services of aluminum door manufacturer's field representative to observe for proper installation of system and submit report.
- B. See Section 014000 - Quality Requirements, for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.

### 3.04 CLEANING

- A. Upon completion of installation, thoroughly clean door and frame surfaces in accordance with AAMA 609 & 610.
- B. Do not use abrasive, caustic, or acid cleaning agents.

### 3.05 PROTECTION

- A. Protect products of this section from damage caused by subsequent construction until Date of Substantial Completion.

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- B. Replace damaged or defective components that cannot be repaired to a condition indistinguishable from undamaged components.

**END OF SECTION**



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**SECTION 081416  
FLUSH WOOD DOORS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Flush wood doors; flush and flush glazed configuration; fire-rated and non-rated.
- B. Transom panels.

**1.02 RELATED REQUIREMENTS**

- A. Section 088000 - Glazing.

**1.03 REFERENCE STANDARDS**

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.
- B. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- C. AWI (QCP) - Quality Certification Program Current Edition.
- D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
- E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards 2021, with Errata.
- F. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.
- G. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
  - 1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
  - 2. Include certification program label.
- D. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- E. Warranty, executed in Owner's name.

**1.05 QUALITY ASSURANCE**

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
  - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- C. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.
- D. Quality Certification:
  - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: [www.awiqcp.org/#sle](http://www.awiqcp.org/#sle).
  - 2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.

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3. Provide designated labels on shop drawings as required by certification program.
4. Provide designated labels on installed products as required by certification program.
5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

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

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

#### **1.07 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Wood Veneer Faced Doors:
  1. Eggers Industries: [www.eggindustries.com/#sle](http://www.eggindustries.com/#sle).
  2. Graham Wood Doors: [www.grahamdoors.com/#sle](http://www.grahamdoors.com/#sle).
  3. Haley Brothers: [www.haleybros.com/#sle](http://www.haleybros.com/#sle).
  4. Marshfield DoorSystems, Inc: [www.marshfielddoors.com/#sle](http://www.marshfielddoors.com/#sle).
  5. Oregon Door; Architectural Series: [www.oregondoors.com/#sle](http://www.oregondoors.com/#sle).

#### **2.02 DOORS AND PANELS**

- A. Doors: Refer to drawings for locations and additional requirements.
  1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
  1. Provide solid core doors at each location.
  2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.

#### **2.03 DOOR AND PANEL CORES**

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

#### **2.04 DOOR FACINGS**

#### **2.05 DOOR CONSTRUCTION**

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
  1. Provide solid blocks at lock edge for hardware reinforcement.
  2. Provide solid blocking for other throughbolted hardware.
- C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.

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- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F. Provide edge clearances in accordance with the quality standard specified.

## **2.06 ACCESSORIES**

- A. Glazed Openings:
  - 1. Heat-Strengthened and Fully Tempered Glass: ASTM C1048.
  - 2. Fire-Protection-Rated Glass: Safety Certification, 16 CFR 1201, Category II.
- B. Glazing Stops: Rolled steel channel shape, butted corners; prepared for countersink style tamper proof screws.
- C. Astragals for Non-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge.
- D. Astragals for Fire-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge, specifically for double doors.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

### **3.02 INSTALLATION**

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
  - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Field-Finished Doors: Trimming to fit is acceptable.
  - 1. Adjust width of non-rated doors by cutting equally on both jamb edges.
  - 2. Trim maximum of 3/4 inch off bottom edges.
  - 3. Trim fire-rated doors in strict compliance with fire rating limitations.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.
- F. Install door louvers plumb and level.

### **3.03 TOLERANCES**

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

### **3.04 ADJUSTING**

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

**END OF SECTION**

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**SECTION 083100  
ACCESS DOORS AND PANELS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 REFERENCE STANDARDS**

**1.03 SUBMITTALS**

- A. See Section 013000 - 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.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

**PART 2 PRODUCTS**

**2.01 ACCESS DOORS AND PANELS ASSEMBLIES**

**2.02 WALL AND CEILING MOUNTED UNITS**

- A. Manufacturers:
  1. Activar Construction Products Group - JL Industries: [www.activarcpg.com/#sle](http://www.activarcpg.com/#sle).
  2. ACUDOR Products Inc: [www.acudor.com/#sle](http://www.acudor.com/#sle).
    - a. Air-Tight, Water-Tight, Wall and Ceiling Mounted Units: ACUDOR ADWT.
    - b. Fire-Rated Ceiling-Mounted Units - 2 Hours or Less: ACUDOR FWC-5015.
    - c. Fire-Rated Wall-Mounted Units - 2 Hours or Less: ACUDOR FW-5015.
    - d. Ceiling-Mounted Units: ACUDOR GFRG - R.
    - e. Wall and Ceiling Mounted Units: ACUDOR DW-5058.
  3. Babcock-Davis: [www.babcockdavis.com/#sle](http://www.babcockdavis.com/#sle).
  4. Cendrex, Inc: [www.cendrex.com/#sle](http://www.cendrex.com/#sle).
    - a. Wall-Mounted Units: Cendrex CTA, contoured cover concealing frame, hingeless with magnetic cover attachments, adjustable frame size.
    - b. Fire-Rated Wall-Mounted Units - 3 Hours: Cendrex PFI.
    - c. Fire-Rated Wall-Mounted Units - 2 Hours or Less: Cendrex PFI series, insulated.
    - d. Fire-Rated Ceiling-Mounted Units: Cendrex PFI series, downward opening.
    - e. Recess-Mounted Units for Wall Finish: Cendrex AHA, without flange.
    - f. Security Rated Units: Cendrex MDS, medium security.
    - g. Heavy Duty Double Leaf Units: Cendrex LHD-180.
    - h. Heavy Duty Single Leaf Units: Cendrex LHD.
    - i. Insulated Aluminum Units: Cendrex PAL.
    - j. Attic Draft Stop Units: Cendrex DRD.
    - k. Removable Panel Units - No Hinge: Cendrex RMD, metal.
    - l. Concealed Flange and Latch Units: Cendrex CTR-MAG.
    - m. Ceiling Mounted Units: Cendrex GFRG-PUR, with push up radius corners.
  5. Karp Associates, Inc: [www.karpinc.com/#sle](http://www.karpinc.com/#sle).
  6. Milcor, Inc: [www.milcorinc.com/#sle](http://www.milcorinc.com/#sle).
  7. Nystrom, Inc: [www.nystrom.com/#sle](http://www.nystrom.com/#sle).

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8. Studco Building Systems; EZConcept AccessDor : [www.studcosystems.com/#sle](http://www.studcosystems.com/#sle).
- B. Wall and Ceiling Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
  1. Material: Steel.
  2. Door Style: Single thickness with rolled or turned in edges.
  3. Heavy Duty Frames: 14 gage, 0.0747 inch, minimum thickness.
  4. Heavy Duty Single Steel Sheet Door Panels: 14 gage, 0.0747 inch, minimum thickness.
  5. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
  6. Steel Finish: Primed.
  7. Stainless Steel Finish: No. 4 brushed finish. at tile wall finishes
  8. Hardware:
    - a. Hardware for Fire-Rated Units: As required for listing.
    - b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
    - c. Handle: Fixed.
    - d. Latch/Lock: Tamperproof tool-operated cam latch.
    - e. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.
    - f. Inside Latch Release: Mechanism that allows door/panel to be opened from inside.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that rough openings are correctly sized and located.
- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### **3.02 PREPARATION**

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

#### **3.03 INSTALLATION**

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

**END OF SECTION**

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**SECTION 084313  
ALUMINUM-FRAMED STOREFRONTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Aluminum-framed storefront, with vision glass.
- B. Aluminum doors and frames.
- C. Weatherstripping.
- D. Door hardware.

**1.02 RELATED REQUIREMENTS**

- A. Section 087100 - Door Hardware: Hardware items other than specified in this section.

**1.03 REFERENCE STANDARDS**

- A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.
- B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.

**1.04 ADMINISTRATIVE REQUIREMENTS**

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

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
  - 1. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
- D. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

**1.06 QUALITY ASSURANCE**

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
  - 1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
    - a. Insulating Glass Certification Council (IGCC).
    - b. Safety Glazing Certification Council (SGCC).
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

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1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
  - a. North American Contractor Certification (NACC) for glazing contractors.

### 1.07 FIELD CONDITIONS

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

### 1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

## PART 2 PRODUCTS

### 2.01 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

- A. Front-Set Style, Thermally-Broken:
  1. Basis of Design: Arcadia.

### 2.02 MANUFACTURERS

- A. Aluminum-Framed Storefront and Doors:
  1. Arcadia.

### 2.03 STOREFRONT

- A. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a professional engineer registered in the State of California, using performance requirements and design criteria indicated.
- B. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
  1. Glazing Rabbet: For 1 inch insulating glazing.
  2. Finish: Superior performing organic coatings.
  3. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
  4. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
  5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
  6. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
  7. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
  8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

### 2.04 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
  1. Framing members for interior applications need not be thermally broken.
  2. Glazing Stops: Flush.

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- 3. Cross-Section: As indicated on drawings.
- B. Glazing: As specified in Section 088000.
- C. Swing Doors: Glazed aluminum.
  - 1. Thickness: 1-3/4 inches.
  - 2. Top Rail: 4 inches wide.
  - 3. Vertical Stiles: 4-1/2 inches wide.
  - 4. Bottom Rail: 10 inches wide.
  - 5. Glazing Stops: Square.
  - 6. Finish: Same as storefront.

## 2.05 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Fasteners: Stainless steel.
- C. Exposed Flashings: Aluminum sheet, 20 gage, 0.032 inch minimum thickness; finish to match framing members.
- D. Concealed Flashings: Galvanized steel, 26 gage, 0.0179 inch minimum base metal thickness.
- E. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.
- F. Sealant for Setting Thresholds: Non-curing butyl type.
- G. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

## 2.06 FINISHES

- A. Superior Performing Organic Coatings System: Manufacturer's standard multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
- B. Color: As indicated on drawings.

## 2.07 HARDWARE

- A. For each door, include weatherstripping, sill sweep strip, and threshold.
- B. Other Door Hardware: As specified in Section 087100.
- C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
- D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
- E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

## PART 3 EXECUTION

### 3.01 EXAMINATION

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

### 3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.



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- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- I. Set thresholds in bed of sealant and secure.
- J. Install hardware using templates provided.
  - 1. See Section 087100 for hardware installation requirements.
- K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

**3.03 TOLERANCES**

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

**3.04 FIELD QUALITY CONTROL**

- A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.

**3.05 ADJUSTING**

- A. Adjust operating hardware and sash for smooth operation.

**3.06 CLEANING**

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

**3.07 PROTECTION**

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

**END OF SECTION**

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**SECTION 086223  
TUBULAR SKYLIGHTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Tubular skylights, consisting of skylight dome, reflective tube, and diffuser assembly.

**1.02 RELATED REQUIREMENTS**

- A. Section 260583 - Wiring Connections: Electrical connections.

**1.03 REFERENCE STANDARDS**

- A. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position 2022.
- B. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings 2020a.
- C. UL (DIR) - Online Certifications Directory Current Edition.
- D. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 013000 - 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.
- C. Shop Drawings: Indicate configurations, dimensions, locations, fastening methods, and installation details.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than ten years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

**1.07 FIELD CONDITIONS**

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

**1.08 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Skylights: Manufacturer's standard warranty for 10 years.
- C. Electrical Parts: Manufacturer's standard warranty for three years, unless otherwise indicated.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Solatube International, Inc; SolaMaster: [www.solatube.com/#sle](http://www.solatube.com/#sle).

**2.02 TUBULAR SKYLIGHTS**

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- A. Tubular Skylights: Transparent roof-mounted skylight dome and curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces.
  - 1. Fabrication and assembly of components is by single manufacturer.
  - 2. Non-Metal Parts: Flammability less than the following.
    - a. Roof-Top Components: Class B when tested in accordance with ASTM E108 or UL 790.
    - b. Combustibility - Light Transmitting Parts: Minimum 2.5 inches/min (ICC Class CC-2), when tested in accordance with ASTM D635.
- B. Roof Assemblies: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
  - 1. Glazing: Acrylic plastic, 1/8 inch minimum thickness.
  - 2. Base: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube.
  - 3. Base Material: Sheet steel, galvanized, ASTM A653/A653M, 24 gage, 0.0239 inch thick, minimum.
  - 4. Base Height: 4 inches.
  - 5. Flashing Extensions: Provide manufacturer's standard adaptors or extensions for tile applications and slopes greater than 8:12.
  - 6. Dome Ring: Attached to top of base section; 0.090 inch nominal thickness injection molded high impact ABS; to prevent thermal bridging between base flashing and tubing and channel condensed moisture out of tubing; weather seal of medium density pile weather stripping.
- C. Reflective Tube: ASTM B209 (ASTM B209M) aluminum sheet, thickness between 0.015 inch and 0.020 inch.
  - 1. Interior Finish: Exposed interior surfaces of high reflectance specular finish; specular reflectance of 92, total reflectance 95 percent.
- D. Diffuser Assemblies: Supporting light transmitting surface at bottom termination of tube, with compression seal to minimize condensation and bug or dirt infiltration.
  - 1. Ceiling Ring: Edge trim for ceiling opening; injection molded high impact ABS.
  - 2. Diffuser Trim: Edge and attachment trim for diffuser lens; injection molded high impact ABS.
  - 3. Lens: Flush frosted lens.
  - 4. Lens Material: Acrylic plastic.
  - 5. Visible Light Transmission (VLT): 90 percent, minimum.
  - 6. Seal: Closed cell EPDM foam rubber.

### 2.03 ACCESSORIES

- A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.
- B. Sealant: Elastomeric, silicone or polyurethane; compatible with materials being sealed.
- C. Lighting Fixtures: Bracket mounted inside skylight tube just above diffuser; UL (DIR) listed.
  - 1. Type: Compact fluorescent fixture, for 26 W lamps, 1 lamp per tube.
  - 2. Electrical Requirements: 110 V, 15 amp GFCI circuit.
  - 3. Contractor to furnish lamps.
- D. Daylight Dimmer: Electro-mechanically actuated daylight valve; for universal input voltages ranging between 90 and 277 V at 50 or 60 Hz; actuator rated at 0.1 amp per unit; controlled by low voltage, series circuited, 4 conductor, size 22 cable, and low voltage DC DP/DT switch; providing daylight output between 2 and 100 percent.

## PART 3 EXECUTION

### 3.01 EXAMINATION

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

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- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

**3.02 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

**3.03 INSTALLATION**

- A. Install in accordance with manufacturer's written instructions.
- B. Set roof assembly flashing in continuous bead of sealant.
- C. Seal joints exposed to weather in accordance with sealant manufacturer's written instructions.
- D. Conduct field test for water tightness; conduct water test in presence of Architect. Correct defective work and re-test until satisfactory.

**3.04 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

**END OF SECTION**

## SECTION 08 71 00 – DOOR HARDWARE

### 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. Mechanical and electrified door hardware for:
  - a. Swinging doors.
- 2. Electronic access control system components, including:
  - a. Electronic access control devices.
- 3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.

- B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

- 1. Windows
- 2. Cabinets (casework), including locks in cabinets
- 3. Signage
- 4. Toilet accessories
- 5. Overhead doors

- C. Related Sections:

- 1. Division 01 Section "Alternates" for alternates affecting this section.
- 2. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
- 3. Division 09 sections for touchup finishing or refinishing of existing openings modified by this section.
- 4. Division 13 Section "Radiation Protection" for requirements for lead-lining for door hardware at openings indicated to receive radiation protection.
- 5. Division 26 sections for connections to electrical power system and for low-voltage wiring.
- 6. Division 28 sections for coordination with other components of electronic access control system.

### 1.3 REFERENCES

- A. UL - Underwriters Laboratories
  - 1. UL 10B - Fire Test of Door Assemblies
  - 2. UL 10C - Positive Pressure Test of Fire Door Assemblies
  - 3. UL 1784 - Air Leakage Tests of Door Assemblies
  - 4. UL 305 - Panic Hardware
- B. ANSI - American National Standards Institute
  - 1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
- C. California Code of Regulations
  - 1. Title 24: California Building Standards Code

### 1.4 SUBMITTALS

- A. General:
  - 1. Submit in accordance with Conditions of Contract and Division 01 requirements.
  - 2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
  - 3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.
- B. Action Submittals:
  - 1. Product Data: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
  - 2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
    - a. Wiring Diagrams: For power, signal, and control wiring and including:
      - 1) Details of interface of electrified door hardware and building safety and security systems.
      - 2) Schematic diagram of systems that interface with electrified door hardware.
      - 3) Point-to-point wiring.
      - 4) Risers.
  - 3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
    - a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
    - a. Door Index; include door number, heading number, and Architects hardware set number.
    - b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
    - c. Type, style, function, size, and finish of each hardware item.
    - d. Name and manufacturer of each item.
    - e. Fastenings and other pertinent information.
    - f. Location of each hardware set cross-referenced to indications on Drawings.
    - g. Explanation of all abbreviations, symbols, and codes contained in schedule.
    - h. Mounting locations for hardware.
    - i. Door and frame sizes and materials.
    - j. Name and phone number for local manufacturer's representative for each product.
    - k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components).  
Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.
      - 1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.
  5. Key Schedule:
    - a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
    - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
    - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
    - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
    - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
      - 1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
    - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
  6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.
- C. Informational Submittals:
1. Qualification Data: For Supplier and Installer.
  2. Product Certificates for electrified door hardware, signed by manufacturer:

- a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
  3. Certificates of Compliance:
    - a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
    - b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
    - c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.
  4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.
  5. Warranty: Special warranty specified in this Section.
- D. Closeout Submittals:
1. Operations and Maintenance Data : Provide in accordance with Division 01 and include:
    - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
    - b. Catalog pages for each product.
    - c. Name, address, and phone number of local representatives for each manufacturer.
    - d. Parts list for each product.
    - e. Final approved hardware schedule edited to reflect conditions as-installed.
    - f. Final keying schedule
    - g. Copies of floor plans with keying nomenclature
    - h. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
    - i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

## 1.5 QUALITY ASSURANCE

- A. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.
1. Where specific manufacturer's product is named and accompanied by "No Substitute," including make or model number or other designation, provide product specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)
    - a. Where no additional products or manufacturers are listed in product category, requirements for "No Substitute" govern product selection.
  2. Where products indicate "acceptable manufacturers" or "acceptable manufacturers and products", provide product from specified manufacturers, subject to compliance with specified requirements and "Single Source Responsibility" requirements stated herein.



- B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project.
  - 1. Warehousing Facilities: In Project's vicinity.
  - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
  - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
  - 4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
    - a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
- C. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.
- D. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
  - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
  - 2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- E. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
- F. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
  - 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
- G. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
- H. Means of Egress Doors: Latches do not require more than 5 lbf (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.
- I. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in "REFERENCES" article, herein.
  - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf (22.2 N).
  - 2. Maximum opening-force requirements:

- a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
    - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
    - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
  3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
  4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.
- J. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.
1. Attendees: Owner, Contractor, Architect, Installer, **Owner's Security Consultant**, and Supplier.
  2. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
    - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
    - b. Preliminary key system schematic diagram.
    - c. Requirements for key control system.
    - d. Requirements for access control.
    - e. Address for delivery of keys.
- K. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  2. Inspect and discuss preparatory work performed by other trades.
  3. Inspect and discuss electrical roughing-in for electrified door hardware.
  4. Review sequence of operation for each type of electrified door hardware.
  5. Review required testing, inspecting, and certifying procedures.
- L. Coordination Conferences:
1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
    - a. Attendees: Door hardware supplier, door hardware installer, Contractor.
    - b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.
  2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
    - a. Attendees: electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner, **Owner's security consultant**, Architect and Contractor.
    - b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
  - 1. Deliver each article of hardware in manufacturer's original packaging.
- C. Project Conditions:
  - 1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
  - 2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- D. Protection and Damage:
  - 1. Promptly replace products damaged during shipping.
  - 2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
  - 3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- F. Deliver keys **and permanent cores** to Owner by registered mail or overnight package service.

## 1.7 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

- F. Direct shipments not permitted, unless approved by Contractor.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Years from date of Substantial Completion, for durations indicated.
    - a. Closers:
      - 1) Mechanical: 10 years. **30 years for LCN 4000**
    - b. Exit Devices:
      - 1) Mechanical: 3 years.
      - 2) Electrified: 1 year.
    - c. Locksets:
      - 1) Mechanical: 3 years
      - 2) Electrified: 1 year.
    - d. Continuous Hinges: Lifetime warranty.
    - e. Key Blanks: Lifetime
  - 2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

## 1.9 REGULATORY REQUIREMENTS:

- A. Locate latching hardware between 34 inches to 44 inches above the finished floor, per 2019 California Building Code, Section 11B-404.2.7.
  - 1. Panic hardware: locate between 36 inches to 44 inches above the finished floor.
- B. Handles, pull, latches, locks, other operable parts:
  - 1. Readily openable from egress side with one hand and without tight grasping, tight pinching, or twisting of the wrist to operate. 2019 California Building Code Section 11B-309.4.
  - 2. Force required to activate the operable parts: 5.0 pounds maximum, per 2019 California Building Code Section 11B-309.4.
- C. Adjust doors to open with not more than 5.0-pounds pressure to open at exterior doors and 5.0-pounds at interior doors. As allowed per 2019 California Building Code Section 11B-404.2.9, local authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15-pounds.
  - 1. Exception: exterior doors' pressure-to-open may be increased to 8.5-pounds if: at a single location, and one of a bank of eight leafs or fraction of eight, and one leaf of this bank is fitted with a low- or high-energy operator.
- D. Adjust door closer sweep periods so that from an open position of 90 degrees, the door will take at least 5 seconds to move to a point 12 degrees from the latch, measured to the landing side of the door, per 2019 California Building Code Section 11B-404.2.8.

1. Spring hinges: adjust for 1.5 seconds minimum for 70 degrees to fully-closed.
- E. Smooth surfaces at bottom 10 inches of push sides of doors, facilitating push-open with wheelchair footrests, per 2019 California Building Code Section 11B-404.2.10.
  1. Applied kickplates and armor plates: bevel the left and right edges; free of sharp or abrasive edges.
  2. Tempered glass doors without stiles: bottom rail may be less than 10 inches if top leading edge is tapered 60 degrees minimum.
- F. Door opening clear width no less than 32 inches, measured from face of frame stop, or edge of inactive leaf of pair of doors, to door face with door opened to 90 degrees. Hardware projection not a factor in clear width if located above 30 inches and below 80 inches, and the hardware projects no more than 4 inches. 2019 California Building Code Section 11B-404.2.3.
  1. Exception: In alterations, a projection of 5/8 inch (15.9 mm) maximum into the required clear width shall be permitted for the latch side stop.
  2. Door closers and overhead stops: not less than 78 inches above the finished floor or ground, per 2019 California Building Code 11B-307.4.
- G. Thresholds: floor or landing no more than 0.50 inches below the top of the threshold of the doorway, per 2019 California Building Code Section 11B-404.2.5. Vertical rise no more than 0.25 inches, change in level between 0.25 inches and 0.50 inches: beveled to slope no greater than 1:2 (50 percent slope). 2019 California Building Code Section 11B-303.2 & ~.3.
- H. Floor stops: Do not locate in path of travel. Locate no more than 4 inches from walls, per DSA Policy #99-08 (Access).
- I. Pairs of doors with independently-activated hardware both leafs: limit swing of right-hand or right-hand-reverse leaf to 90 degrees to protect persons reading wall-mounted tactile signage, per 2019 California Building Code Section 11B-703.4.2.
- J. Door and door hardware encroachment: when door is swung fully-open into means-of-egress path, the door may not encroach/project more than 7 inches into the required exit width, with the exception of door release hardware such as lockset levers or panic hardware. These hardware items must be located no less than 34-inches and no more than 44-inches above the floor/ground. 2019 California Building Code, Section 1005.7.1.
- K. In I-2 occupancies, latch release hardware is not permitted to project in the required exit width, regardless of its mounting height, per 2019 California Building Code, Section 1005.7.1 at Exception 1.

#### 1.10 MAINTENANCE

- A. Extra Materials:
- B. Maintenance Tools:
  1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
  - 2.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturer" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
- E. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

### 2.2 MATERIALS

- A. Fasteners
  - 1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
  - 2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
  - 3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
  - 4. Install hardware with fasteners provided by hardware manufacturer.
- B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.
  - 1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
  - 2. Use materials which match materials of adjacent modified areas.
  - 3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.
- C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.
- D. Cable and Connectors: Hardwired Electronic Access Control Lockset and Exit Device Trim:
1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.
  2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
  3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.
  4. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with sufficient number and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

## 2.3 HINGES

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Ives 5BB series
2. Acceptable Manufacturers and Products: Hager BB series, McKinney TA/T4A series, Stanley FBB Series

### B. Requirements:

1. Provide five-knuckle ball bearing hinges conforming to ANSI/BHMA A156.1.
2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
  - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
  - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
  - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
  - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
4. 2 inches or thicker doors:
  - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
  - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
  - a. Steel Hinges: Steel pins
  - b. Non-Ferrous Hinges: Stainless steel pins
  - c. Out-Swinging Exterior Doors: Non-removable pins
  - d. Out-Swinging Interior Lockable Doors: Non-removable pins
  - e. Interior Non-lockable Doors: Non-rising pins

8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
9. Doors 36 inches (914 mm) wide or less furnish hinges 4-1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.
10. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.
11. Provide mortar guard for each electrified hinge specified.

## 2.4 CONTINUOUS HINGES

### A. Aluminum Geared

1. Manufacturers:
  - a. Scheduled Manufacturer: Ives.
  - b. Acceptable Manufacturers: Markar, Stanley.
2. Requirements:
  - a. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
  - b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum, with 0.25-inch (6 mm) diameter Teflon coated stainless steel hinge pin.
  - c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
  - d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
  - e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
  - f. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
  - g. Install hinges with fasteners supplied by manufacturer.
  - h. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

## 2.5 FLUSH BOLTS

### A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Rockwood, Trimco

### B. Requirements:



1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

## 2.6 COORDINATORS

### A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Rockwood, Trimco

### B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers and surface vertical rod exit device strikes. Factory-prep coordinators for vertical rod devices if required.

## 2.7 MORTISE LOCKS

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage L9000 series

### B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1 Operational, Grade 1 Security, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
2. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
3. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
4. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide a request to exit (RX) switch that is actuated with rotation of inside lever.
5. Provide motor based electrified locksets with electrified options as scheduled in the hardware sets and comply with the following requirements:
  - a. Universal input voltage – single chassis accepts 12 or 24V DC to allow for changes in the field without changing lock chassis.
  - b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case
  - c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.

- d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
  - e. Request to Exit Switch (RX) –
    - 1) Modular Design – provide electrified locks capable of using, adding, or changing a modular RX switch without opening the lock case.
    - 2) Monitoring – where scheduled, provide a request to exit (RX) switch that detects rotation of the inside lever.
  - f. Connections – provide quick-connect Molex system standard.
  - g. UL Listed – 3 hour fire door
6. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
- a. Lever Design: Schlage **06A**.
  - b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

## 2.8 CYLINDRICAL LOCKS – GRADE 1

### A. Manufacturers and Products:

- 1. Scheduled Manufacturer and Product: Schlage ND Series

### B. Requirements:

- 1. Provide cylindrical locks conforming to the following standards and requirements:
  - a. ANSI/BHMA A156.2 Series 4000, Grade 1.
  - b. UL 10C for 4'-0" x 10'-0" 3-hour fire door.
- 2. Cylinders: Refer to “KEYING” article, herein.
- 3. Provide cylindrical locksets exceeding the ANSI/BHMA A156.2 Grade 1 performance standards for strength, security, and durability in the categories below:
  - a. Abusive Locked Lever Torque Test – minimum 3,100 inch-pounds without gaining access
  - b. Cycle life - tested to minimum 10 million cycles per ANSI/BHMA A156.2 Cycle Test with no visible lever sag or use of performance aids such as set screws or spacers.
- 4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
- 5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
- 6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
- 7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
- 8. Provide electrified options as scheduled in the hardware sets.
- 9. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.
  - a. Lever Design: Schlage Rhodes.

- b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

## 2.9 AUXILIARY LOCKS

### A. Deadlocks:

#### 1. Manufacturers and Products:

- a. Scheduled Manufacturer and Product: Schlage L9000 series

#### 2. Requirements:

- a. Provide mortise deadlock series conforming to ANSI/BHMA A156 and function as specified. Cylinders: Refer to "KEYING" article, herein.
- b. Provide deadlocks with standard 2-3/4 inches (70 mm) backset. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
- c. Provide manufacturer's standard strike.

### B. Deadbolts:

#### 1. Manufacturers and Products:

- a. Scheduled Manufacturer and Product: Schlage B600 series
- b. Acceptable Manufacturers and Products: Arrow N series, Best T series, Corbin-Ruswin DL3000 series, Falcon D100 series, Sargent 480 series.

#### 2. Requirements:

- a. Provide deadbolt series conforming to ANSI/BHMA A156 and function as specified. Cylinders: Refer to "KEYING" article, herein.
- b. Provide deadbolts with standard 2-3/4 inches (70 mm) backset. Provide 2-3/8 inches (60 mm) where noted or if door or frame detail requires. Provide deadbolt with full 1 inch (25 mm) throw, constructed of steel alloy.
- c. Provide manufacturer's standard strike.

## 2.10 EXIT DEVICES:

### A. Manufacturers and Products:

- 1. Scheduled Manufacturer and Product: Von Duprin 99/33 series

### B. Requirements:

- 1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, and UL listed for Panic Exit or Fire Exit Hardware. Cylinders: Refer to "KEYING" article, herein.
- 2. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
- 3. Touchpad: Extend minimum of one half of door width. Match exit device finish, stainless steel for US26, US26D, US28, US32, and US32D finishes; and for all other finishes, provide compatible finish to exit device. No plastic inserts are allowed in touchpads.

4. Provide exit devices with dead-latching feature for security and for future addition of alarm kits and/or other electrified requirements.
5. Provide flush end caps for exit devices.
6. Provide exit devices with manufacturer's approved strikes.
7. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
8. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
9. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
10. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
  - a. Lever Style: Match lever style of locksets.
  - b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.
11. Provide UL labeled fire exit hardware for fire rated openings.
12. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
13. Provide electrified options as scheduled.

#### 2.11 ELECTRONIC ACCESS CONTROL LOCKSETS AND EXIT DEVICE TRIM

- A. See Division 28:

#### 2.12 CYLINDERS:

- A. Requirements:

1. Provide permanent interchangeable Small format interchangeable core SFIC. cylinders, compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Replaceable Construction Cores. OPTION if using temporary construction cores in IC core cylinder in either F/S or S/F.
  - a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
    - 1) 3 construction control keys
    - 2) 12 construction change (day) keys.
  - b. Owner or Owner's Representative will replace temporary construction cores with permanent cores.

## 2.13 KEYING

- A. Provide cylinders/cores keyed into Owner's existing factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- B. Manufacturer:
  - 1. Best Lock Co. Provide permanent cores keyed into the existing key system
- C. Requirements:
  - 1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
    - a. Master Keying system as directed by the Owner.
    - b. Option: No Master Keying: Cylinders/cores only operated by change (day) keys.
  - 2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements shall be cause for replacement of cylinders/cores involved at no additional cost to Owner.
  - 3. Provide keys with the following features:
    - a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
  - 4. Identification:
    - a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Blind code marks shall not include actual key cuts.
    - b. Identification stamping provisions must be approved by the Architect and Owner.
    - c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE".
    - d. Failure to comply with stamping requirements shall be cause for replacement of keys involved at no additional cost to Owner.
    - e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
  - 5. Quantity: Furnish in the following quantities.
    - a. Change (Day) Keys: 3 per cylinder/core.
    - b. Option for LFIC or SFIC: Permanent Control Keys: 3.
    - c. Master Keys: 6.

## 2.14 DOOR CLOSERS OPTION:

- A. Manufacturers and Products:
  - 1. Scheduled Manufacturer and Product: LCN 4040XP series.
  - 2. Acceptable Manufacturers and Products: No Substitute.
- B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch (38 mm) diameter with 3/4 inch (19 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

## 2.15 DOOR TRIM

### A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Rockwood, Trimco

### B. Requirements:

1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

## 2.16 PROTECTION PLATES

### A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Rockwood, Trimco

B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
  - a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
  - b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
  - c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

## 2.17 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers: Glynn-Johnson
2. Acceptable Manufacturers: Rixson, Sargent

B. Requirements:

1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

## 2.18 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Rockwood, Trimco

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.

3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

## 2.19 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

### A. Manufacturers:

1. Scheduled Manufacturer: Zero International
2. Acceptable Manufacturers: National Guard, Pemko

### B. Requirements:

1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Size of thresholds:
  - a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
  - b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

## 2.20 SILENCERS

### A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Rockwood, Trimco

### B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

## 2.21 LATCH PROTECTORS

### A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Rockwood, Trimco

- ### B. Provide stainless steel latch protectors of type required to function with specified lock.

## 2.22 COAT HOOKS

### A. Manufacturers:



1. Scheduled Manufacturer: Ives.
  2. Acceptable Manufacturers: Rockwood, Trimco
- B. Provide coat hooks as specified.

## 2.23 FINISHES

- A. Finish: BHMA 626/652 (US26D); except:
1. Hinges at Exterior Doors: BHMA 630 (US32D)
  2. Continuous Hinges: BHMA 630 (US32D)
  3. Continuous Hinges: BHMA 628 (US28)
  4. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
  5. Protection Plates: BHMA 630 (US32D)
  6. Overhead Stops and Holders: BHMA 630 (US32D)
  7. Door Closers: Powder Coat to Match
  8. Wall Stops: BHMA 630 (US32D)
  9. Latch Protectors: BHMA 630 (US32D)
  10. Weatherstripping: Clear Anodized Aluminum
  11. Thresholds: Mill Finish Aluminum

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Where on-site modification of doors and frames is required:
1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
  2. Field modify and prepare existing door and frame for new hardware being installed.
  3. When modifications are exposed to view, use concealed fasteners, when possible.
  4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:

- a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
- c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

### 3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
  1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  2. Custom Steel Doors and Frames: HMMA 831.
  3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce 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 according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
- I. Lock Cylinders: Install construction cores to secure building and areas during construction period.
  1. Replace construction cores with permanent cores as indicated in keying section.
- J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.

- L. Closer/holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- M. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- N. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- O. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- P. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- Q. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

### 3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
  - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

### 3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

### 3.6 DEMONSTRATION

- A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

### 3.7 DOOR HARDWARE SCHEDULE

- A. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type and function. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.
- B. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- C. Hardware Sets:

Hardware Group No. 01 - PH, FIELD VERIFY ACTUAL DOOR SIZE

For use on Door #(s):

(E) 271A      (E) 271B      (E) 271C      (E) 334B      (E) 334C      (E) 334C

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1HW 5 X 4.5 NRP		630	IVE
1	EA	REMOVABLE MULLION	KR4954		689	VON
1	EA	PANIC HARDWARE	LD-PA-AX-99-EO		626	VON
1	EA	PANIC HARDWARE	LD-PA-AX-99-EO		626	VON
1	EA	MULLION STABILIZER	154		SP28	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-400-993R-70-MT-RHO-B 4AA BATTERY		⚡ 626	SCE
2	EA	SFIC MORTISE CYL.	20-061 ICX (CAM AS REQ)		626	SCH
2	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
2	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA - OMIT IF SHELTERED		BK	ZER
1	EA	GASKETING	50AA-S		AA	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	102A OR PER SILL DETAIL		A	ZER
2	EA	DOOR CONTACT	679-05HM/WD AS REQ		⚡ BLK	SCE
1	EA	CARD READER	SUPPLIED BY DIV 28 COORDINATE W/ ACCESS CONTROL SUPPLIER		⚡	

EXIT DEVICE TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIV 28

PIM TO BE PROVIDED BY DIV 28

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

Hardware Group No. 02 - PH

5 INCH MINIMUM STILE REQUIRE FOR HARDWARE SPECIFIED

For use on Door #(s):

(E)347 (E)362A (E)364 (E)508A (E) 132A (E) 132B  
 (E) 143 (E) 145A (E)H10

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	PANIC HARDWARE	LD-PA-AX-99-EO		626	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-400-993R-70-MT-RHO-B 4AA BATTERY		626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	RAIN DRIP	142AA - OMIT IF SHELTERED		BK	ZER
1	EA	GASKETING	50AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	102A OR PER SILL DETAIL		A	ZER
1	EA	DOOR CONTACT	679-05HM/WD AS REQ		BLK	SCE
1	EA	CARD READER	SUPPLIED BY DIV 28 COORDINATE W/ ACCESS CONTROL SUPPLIER			

EXIT DEVICE TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28

PIM TO BE PROVIDED BY DIV 28

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

Hardware Group No. 03

For use on Door #(s):

118

Provide each SGL door(s) with the following:










QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	L9070HD 06A		626	SCH
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

Hardware Group No. 04

For use on Door #(s):

(E)290B	(E)290C	(E)293A	(E)293B	(E)295A	(E)301B
(E)385C	(E)386	(E)387B	(E)388B	(E)390B	(E)391B
(E)392A	(E)392B	(E) 270A	(E) 272	(E) 274C	(E) 277B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5 NRP		630	IVE
1	EA	STOREROOM MORT LOCK W/LED INDICATOR	LEBMS-ADDHD-06 BATTERY OPERATED LOCKSET OPERATED BY ENGAGE SOFTWARE	 ↗	626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS18S/L AS REQ		BLK	IVE
1	EA	RAIN DRIP	142AA - OMIT IF SHELTERED		BK	ZER
1	EA	GASKETING	50AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	102A OR PER SILL DETAIL		A	ZER

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

LOCKS AND GATEWAYS TO BE PROVIDED DIV 28

TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28

Hardware Group No. 05

For use on Door #(s):

(E)301A          (E)302A          (E)306A          (E)441          (E) 337C

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 5 X 4.5 NRP		630	IVE
1	SET	AUTO FLUSH BOLT	FB31P		630	IVE
1	EA	DUST PROOF STRIKE	DP1 OR DP2 AS REQ'D		626	IVE
1	EA	STOREROOM MORT LOCK W/LED INDICATOR	LEBMS-ADDHD-06 BATTERY OPERATED LOCKSET OPERATED BY ENGAGE SOFTWARE		626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	COORDINATOR	COR X FL X MB		628	IVE
2	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	FLOOR STOP	FS18S/L AS REQ		BLK	IVE
1	EA	RAIN DRIP	142AA - OMIT IF SHELTERED		BK	ZER
1	EA	GASKETING	50AA-S		AA	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	ASTRAGAL	43SP		SP	ZER
1	EA	THRESHOLD	102A OR PER SILL DETAIL		A	ZER

LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28

TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING



Hardware Group No. 06 - PH, FIELD VERIFY ACTUAL DOOR SIZE

For use on Door #(s):

(E)201A      (E)201B      (E)201C      (E)358A      (E)358B      (E) 325A  
 (E) 325B      (E) 336A      (E) 338B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	REMOVABLE MULLION	KR4954		689	VON
1	EA	PANIC HARDWARE	LD-PA-AX-99-EO		626	VON
1	EA	PANIC HARDWARE	LD-PA-AX-99-EO		626	VON
1	EA	MULLION STABILIZER	154		SP28	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-400-993R-70-MT-RHO-B 4AA BATTERY		626	SCE
2	EA	SFIC MORTISE CYL.	20-061 ICX (CAM AS REQ)		626	SCH
2	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
2	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA - OMIT IF SHELTERED		BK	ZER
1	EA	GASKETING	50AA-S		AA	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	102A OR PER SILL DETAIL		A	ZER
2	EA	DOOR CONTACT	679-05HM/WD AS REQ		BLK	SCE
1	EA	CARD READER	SUPPLIED BY DIV 28 COORDINATE W/ ACCESS CONTROL SUPPLIER			

EXIT DEVICE TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIV 28

PIM TO BE PROVIDED BY DIV 28









FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

Hardware Group No. 07

For use on Door #(s):

(E)240	(E)245	(E)246	(E)247A	(E)247B	(E)248A
(E)248B	(E)249	(E)250	(E)251	(E)251A	(E)252
(E)253	(E)254	(E)255	(E)348	(E)349	(E)350A
(E)350B	(E)360A	(E)361A	(E)363A	(E)365A	(E)365B
(E)366A	(E)366B	(E)501A	(E)501B	(E)502A	(E)502B
(E)503A	(E)503B	(E)504A	(E)504B	(E)505A	(E)505B
(E)506A	(E)506B	(E)507A	(E)507B	(E)508B	(E)509A
(E)510A	(E)510B	(E)511A	(E)512A	(E)512B	(E)513A
(E)513B	(E)514	(E)515	(E)516	(E) 101A	(E) 335
(E) 340C1	(E) 341A				

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		630	IVE
1	EA	STOREROOM MORT LOCK W/LED INDICATOR	LEBMS-ADDHD-06 BATTERY OPERATED LOCKSET OPERATED BY ENGAGE SOFTWARE	 ↗	626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA - OMIT IF SHELTERED		BK	ZER
1	EA	GASKETING	50AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	102A OR PER SILL DETAIL		A	ZER

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28

TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28

Hardware Group No. 08 - PH, FIELD VERIFY ACTUAL DOOR SIZE

For use on Door #(s):

(E)338A (E) 334F

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 5 X 4.5 NRP		630	IVE
1	EA	REMOVABLE MULLION	KR4954		689	VON
1	EA	PANIC HARDWARE	LD-PA-AX-99-EO		626	VON
1	EA	PANIC HARDWARE	LD-PA-AX-99-EO		626	VON
1	EA	MULLION STABILIZER	154		SP28	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-400-993R-70-MT-RHO-B 4AA BATTERY		626	SCE
2	EA	SFIC MORTISE CYL.	20-061 ICX (CAM AS REQ)		626	SCH
2	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
2	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA - OMIT IF SHELTERED		BK	ZER
1	EA	GASKETING	50AA-S		AA	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	102A OR PER SILL DETAIL		A	ZER
2	EA	DOOR CONTACT	679-05HM/WD AS REQ		BLK	SCE
1	EA	CARD READER	SUPPLIED BY DIV 28 COORDINATE W/ ACCESS CONTROL SUPPLIER			

EXIT DEVICE TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIV 28

PIM TO BE PROVIDED BY DIV 28

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

Hardware Group No. 09

For use on Door #(s):

(E)519 (E) 336B (E) 337B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP		630	IVE
1	SET	AUTO FLUSH BOLT	FB31P		630	IVE
1	EA	DUST PROOF STRIKE	DP1 OR DP2 AS REQ'D		626	IVE
1	EA	STOREROOM MORT LOCK W/LED INDICATOR	LEBMS-ADDHD-06 BATTERY OPERATED LOCKSET OPERATED BY ENGAGE SOFTWARE		626	SCE
1	EA	COORDINATOR	COR X FL X MB		628	IVE
2	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	FLOOR STOP	FS18S/L AS REQ		BLK	IVE
1	EA	RAIN DRIP	142AA - OMIT IF SHELTERED		BK	ZER
1	EA	GASKETING	50AA-S		AA	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	ASTRAGAL	43SP		SP	ZER
1	EA	THRESHOLD	102A OR PER SILL DETAIL		A	ZER

LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28

TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

Hardware Group No. 10

For use on Door #(s):

(E)308

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	WIRELESS ELECTRONIC LOCK	NDEBHD RHO BATTERY OPERATED		626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28

TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28







FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

Hardware Group No. 11

For use on Door #(s):

(E)291B	(E)292A	(E)309	(E)310	(E)385A	(E)388A
(E)390A	(E)403	(E)414	(E)415	(E)416	(E)417
(E)418	(E)422	(E)432			

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	WIRELESS ELECTRONIC LOCK	NDEBHD RHO BATTERY OPERATED	 ↗	626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28

TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28







FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

Hardware Group No. 12

For use on Door #(s):

(E)202	(E)203	(E)204	(E)205	(E)206	(E)241
(E)244	(E)251B	(E)256	(E)257	(E)258	(E)259
(E)260	(E)262	(E)263	(E)265	(E)297	(E)374A
(E)376	(E)378	(E)379	(E)380	(E)381	(E)382
(E)511B	(E)511C	(E) 113	(E) 116	(E) 119	(E) 121
(E) 128	(E) 129	(E) 135	(E) 136	(E) 137	(E) 138A
(E) 138B	(E) 139	(E) 140	(E) 141	(E) 142	(E) 340A
(E) 340B	(E) 340C2				

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	WIRELESS ELECTRONIC LOCK	NDEBHD RHO BATTERY OPERATED	 ↗	626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28












TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

Hardware Group No. 13

For use on Door #(s):  
(E)304

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 5 X 4.5		652	IVE
1	SET	AUTO FLUSH BOLT	FB31P		630	IVE
1	EA	DUST PROOF STRIKE	DP1 OR DP2 AS REQ'D		626	IVE
1	EA	WIRELESS ELECTRONIC LOCK	NDEBHD RHO BATTERY OPERATED		626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	COORDINATOR	COR X FL X MB		628	IVE
2	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	ASTRAGAL	383AA		AA	ZER
2	EA	DOOR SWEEP	39A		A	ZER

LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28

TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28











FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

Hardware Group No. 14

For use on Door #(s):

(E)385B          (E)387A          (E)388C          (E)391A          (E)402          (E) 117

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	SET	AUTO FLUSH BOLT	FB31P		630	IVE
1	EA	DUST PROOF STRIKE	DP1 OR DP2 AS REQ'D		626	IVE
1	EA	WIRELESS ELECTRONIC LOCK	NDEBHD RHO BATTERY OPERATED		626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	COORDINATOR	COR X FL X MB		628	IVE
2	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	ASTRAGAL	383AA		AA	ZER

LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28

TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING












Hardware Group No. 15 - PH, FIELD VERIFY ACTUAL DOOR SIZE

For use on Door #(s):

(E)298

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 5 X 4.5		652	IVE
1	EA	PANIC HARDWARE	LD-PA-AX-9949-EO-LBL		626	VON
1	EA	PANIC HARDWARE	LD-PA-AX-9949-EO-LBL		626	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-400-993R-70-MT-RHO-B 4AA BATTERY		626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
2	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER
2	EA	DOOR CONTACT	679-05HM/WD AS REQ		BLK	SCE
1	EA	CARD READER	SUPPLIED BY DIV 28 COORDINATE W/ ACCESS CONTROL SUPPLIER			

EXIT DEVICE TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIV 28






PIM TO BE PROVIDED BY DIV 28

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

Hardware Group No. 16

For use on Door #(s):  
(E)351A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		628	IVE
1	EA	WIRELESS ELECTRONIC LOCK	NDEBHD RHO BATTERY OPERATED		626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	MOUNTING PLATE	4040-18		689	LCN
1	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1		SEALS	BY DOOR MANUFACTURER			B/O

5 INCH STILES REQUIRED FOR HARDWARE SPECIFIED

TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28









LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

Hardware Group No. 17

For use on Door #(s):  
(E) 110A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		628	IVE
1	EA	STOREROOM MORT LOCK W/LED INDICATOR	LEBMS-ADDHD-06 BATTERY OPERATED LOCKSET OPERATED BY ENGAGE SOFTWARE		626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	MOUNTING PLATE	4040-18		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS18S/L AS REQ		BLK	IVE
1		SEALS	BY DOOR MANUFACTURER			B/O
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	102A OR PER SILL DETAIL		A	ZER

FIELD VEIRFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

5 INCH MINIMUM STILES REQUIRED FOR HARDWARE SPECIFIED

LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28

Hardware Group No. 18

For use on Door #(s):

103A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		628	IVE
1	EA	CLASSROOM LOCK	L9070HD 06A		626	SCH
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	MOUNTING PLATE	4040-18		689	LCN
1	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1		SEALS	BY DOOR MANUFACTURER			B/O

5 INCH STILES REQUIRED FOR HARDWARE SPECIFIED

Hardware Group No. 19 - PH

5 INCH MINUIMUM STILE REQUIRE FOR HARDWARE SPECIFIED

For use on Door #(s):

108A 108B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112XY		628	IVE
1	EA	PANIC HARDWARE	LD-PA-AX-99-EO		626	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-400-993R-70-MT-RHO-B 4AA BATTERY		626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	MOUNTING PLATE	4040-18		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1		SEALS	BY DOOR MANUFACTURER			B/O
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	102A OR PER SILL DETAIL		A	ZER
1	EA	DOOR CONTACT	679-05HM/WD AS REQ		BLK	SCE
1	EA	CARD READER	SUPPLIED BY DIV 28 COORDINATE W/ ACCESS CONTROL SUPPLIER			

EXIT DEVICE TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIV 28

PIM TO BE PROVIDED BY DIV 28

Hardware Group No. 20

For use on Door #(s):  
106C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PUSH PLATE	8200 8" X 16"		630	IVE
1	EA	PULL PLATE	8302 6" 4" X 16"		630	IVE
1	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

Hardware Group No. 21

For use on Door #(s):  
(E)207

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1HW 5 X 4.5 NRP		630	IVE
1	SET	AUTO FLUSH BOLT	FB31P		630	IVE
1	EA	DUST PROOF STRIKE	DP1 OR DP2 AS REQ'D		626	IVE
1	EA	STOREROOM MORT LOCK W/LED INDICATOR	LEBMS-ADDHD-06 BATTERY OPERATED LOCKSET OPERATED BY ENGAGE SOFTWARE		626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	COORDINATOR	COR X FL X MB		628	IVE
2	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	FLOOR STOP	FS18S/L AS REQ		BLK	IVE
1	EA	RAIN DRIP	142AA - OMIT IF SHELTERED		BK	ZER
1	EA	GASKETING	50AA-S		AA	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	ASTRAGAL	43SP		SP	ZER
1	EA	THRESHOLD	102A OR PER SILL DETAIL		A	ZER

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28










TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIV 28

Hardware Group No. 22

For use on Door #(s):

(E)517 (E)518

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		630	IVE
1	EA	STOREROOM MORT LOCK W/LED INDICATOR	LEBMS-ADDHD-06 BATTERY OPERATED LOCKSET OPERATED BY ENGAGE SOFTWARE	 ↗	626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	RAIN DRIP	142AA - OMIT IF SHELTERED		BK	ZER
1	EA	GASKETING	50AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	102A OR PER SILL DETAIL		A	ZER

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28

TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIV 28










Hardware Group No. 23 - PH

5 INCH MINIMUM STILE REQUIRE FOR HARDWARE SPECIFIED

For use on Door #(s):

(E)370            (E)371            (E)372B            (E)373            372A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	FIRE EXIT HARDWARE	PA-AX-99-EO-F		626	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-400-993R-70-MT-RHO-B 4AA BATTERY	 ⚡	626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	DOOR CONTACT	679-05HM/WD AS REQ	 ⚡	BLK	SCE
1	EA	CARD READER	SUPPLIED BY DIV 28 COORDINATE W/ ACCESS CONTROL SUPPLIER	 ⚡		

EXIT DEVICE TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIV 28

PIM TO BE PROVIDED IN DIV 28

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

Hardware Group No. 24

For use on Door #(s):

(E)290A	(E)291A	(E)292B	(E)294A	(E)294B	(E)294C
(E)294D	(E)296	(E)299A	(E)299B	(E)302A1	(E)302B1
(E)302B	(E)302C1	(E)303	(E)305	(E)306B	(E)307
(E)311A	(E)311B	(E)312	(E)313	(E)314A	(E)314B
(E)315A	(E)315B	(E)316	(E)316A1	(E)316B1	(E)316C1
(E)316D1	(E)317	(E)318	(E)408	(E)410A	(E)410B
(E)412	(E)413	(E)419	(E)420	(E)421	(E)424
(E)425	(E)426	(E)427	(E)428	(E)429	(E)430
(E)431	(E)433	(E)434	(E)435	(E)436	(E)437
(E)438	(E)439	(E)440	(E) 269	(E) 273A	(E) 273B
(E) 274A	(E) 274B	(E) 275	(E) 276	(E) 277A	(E) 278
(E) 279	(E) 280	(E) 281	(E) 282	(E) 283A	(E) 284A
(E) 284B	(E) 285	(E) 286	111	conference/stor age room 2	conference/stor age room
door 371 RH	guidance	Office	storage	Vault room to front lobby	

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1 EA	BALANCE OF HARDWARE	REUSE EXISTING HARDWARE		

Hardware Group No. 25

For use on Door #(s):

(E)423	(E)442	(E)443A	(E)443B	(E) 270B	(E) 334D
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Provide each PR door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1 EA	BALANCE OF HARDWARE	REUSE EXISTING HARDWARE		

Hardware Group No. 26

For use on Door #(s):

31

Provide each RU door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1 EA	CORE/CYLINDER	AS REQ		
1 EA	NOTE	ROLL UP DOOR MFG		B/O

Hardware Group No. 27

For use on Door #(s):

32                      33                      34                      35

Provide each RU door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	BALANCE OF HARDWARE	REUSE EXISTING HARDWARE		

Hardware Group No. 28

For use on Door #(s):

(E)J4A

Provide each SGL door(s) with the following:







QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
OPENING NOT FOUND ON PLANS					

Hardware Group No. 29

For use on Door #(s):

244A              246A              247C              252A              254A              256A  
257A              262A              360B              363B              369C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM SECURITY	L9071HD 06A		626	SCH
2	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER







Hardware Group No. 30

For use on Door #(s):

(E) 101B      (E) 110B      (E) 122      (E) 123      (E) 124      (E) 130  
(E) 131      (E) 133      (E) 134      (E) 144A      (E) 146      (E) 147

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	WIRELESS ELECTRONIC LOCK	NDEBHD RHO BATTERY OPERATED	 ↗	626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28

TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28




FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

Hardware Group No. 31

For use on Door #(s):

102

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	WIRELESS ELECTRONIC LOCK	NDEBHD RHO BATTERY OPERATED	 ↗	626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1		SEALS	BY DOOR MANUFACTURER			B/O

LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28







TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28

Hardware Group No. 32

For use on Door #(s):

(E)361B            (E)362B            (E)363C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM SECURITY	L9071HD 06A		626	SCH
2	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

Hardware Group No. 33 - PH, FIELD VERIFY ACTUAL DOOR SIZE

For use on Door #(s):

106A                      106B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	REMOVABLE MULLION	KR4954		689	VON
1	EA	PANIC HARDWARE	LD-PA-AX-99-EO		626	VON
1	EA	PANIC HARDWARE	LD-PA-AX-99-EO		626	VON
1	EA	MULLION STABILIZER	154		SP28	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-400-993R-70-MT-RHO-B 4AA BATTERY		626	SCE
1	EA	SFIC MORTISE CYL.	20-061 ICX (CAM AS REQ)		626	SCH
2	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
2	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA - OMIT IF SHELTERED		BK	ZER
1	EA	GASKETING	50AA-S		AA	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	102A OR PER SILL DETAIL		A	ZER
2	EA	DOOR CONTACT	679-05HM/WD AS REQ		BLK	SCE
1	EA	CARD READER	SUPPLIED BY DIV 28 COORDINATE W/ ACCESS CONTROL SUPPLIER			

EXIT DEVICE TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIV 28

PIM TO BE PROVIDED BY DIV 28

Hardware Group No. 34

For use on Door #(s):

114                      245A                      366C                      367                      368A                      368B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		630	IVE
1	EA	STOREROOM MORT LOCK W/LED INDICATOR	LEBMS-ADDHD-06 BATTERY OPERATED LOCKSET OPERATED BY ENGAGE SOFTWARE		626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA - OMIT IF SHELTERED		BK	ZER
1	EA	GASKETING	50AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	102A OR PER SILL DETAIL		A	ZER

LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28

TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28

Hardware Group No. 35

For use on Door #(s):

132C                      144B                      145B                      341B                      342                      342A  
 342B                      342C                      342D                      368C                      369A                      369B  
 372C                      374B                      375                      377A                      377B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	WIRELESS ELECTRONIC LOCK	NDEBHD RHO BATTERY OPERATED		626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28











TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28

Hardware Group No. 36

For use on Door #(s):

339A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	SET	AUTO FLUSH BOLT	FB31P		630	IVE
1	EA	DUST PROOF STRIKE	DP1 OR DP2 AS REQ'D		626	IVE
1	EA	WIRELESS ELECTRONIC LOCK	NDEBHD RHO BATTERY OPERATED		626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	COORDINATOR	COR X FL X MB		628	IVE
2	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	ASTRAGAL	383AA		AA	ZER










LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28

TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28

Hardware Group No. 37

For use on Door #(s):  
344

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CONST LATCHING BOLT	FB61T		630	IVE
1	EA	WIRELESS ELECTRONIC LOCK	NDEBHD RHO BATTERY OPERATED		626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	COORDINATOR	COR X FL X MB		628	IVE
2	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	ASTRAGAL	383AA		AA	ZER













LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28

TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIVISION 28

Hardware Group No. 38

For use on Door #(s):  
(E)359

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1HW 5 X 4.5 NRP		630	IVE
1	EA	CONST LATCHING BOLT	FB61T		630	IVE
1	EA	STOREROOM MORT LOCK W/LED INDICATOR	LEBMS-ADDHD-06 BATTERY OPERATED LOCKSET OPERATED BY ENGAGE SOFTWARE	 ↗	626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD		626	BES
1	EA	COORDINATOR	COR X FL X MB		628	IVE
2	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	FLOOR STOP	FS18S/L AS REQ		BLK	IVE
1	EA	RAIN DRIP	142AA - OMIT IF SHELTERED		BK	ZER
1	EA	GASKETING	50AA-S		AA	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	ASTRAGAL	43SP		SP	ZER
1	EA	THRESHOLD	102A OR PER SILL DETAIL		A	ZER

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

LOCKS AND GATEWAYS TO BE PROVIDED IN DIV 28



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IN DIV 28

Hardware Group No. 39 - JAMB POSTS TO HAVE STEEL POSITIONED TO SERVE AS A POSITIVE STOP; GATE CANNOT SWING PAST HARDWARE STRIKES.

For use on Door #(s):

G-2	G-3	G-4	G-5	G-6	G-8
G-9	G-10	G-13			

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
	EA	GATE HINGES/PIVOTS (QUANTITY AS REQ)	BY GATE FABRICATOR		B/O
2	EA	HYDRAULIC GATE CLOSER	BY GATE FABRICATOR		B/O
1	EA	CANE BOLT	BY GATE MANUFACTURER	626	B/O
1	EA	STOREROOM MORT LOCK W/LED INDICATOR	LEBMS-ADDHD-06 BATTERY OPERATED LOCKSET OPERATED BY ENGAGE SOFTWARE	 626	SCE
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD	626	BES
1	EA	MORTISE GATE BOX (WELDED)	BY GATE FABRICATOR		
2	EA	FLOOR STOP	FS18S/L AS REQ BALANCE OF HARDWARE BY GATE FABRICATOR	 BLK	IVE

PIVOTS, WELDED SECURITY SCREEN, AND WELDED PLATE FOR PANIC HARDWARE BY GATE FABRICATOR

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PIM TO BE PROVIDED BY DIV 28

WELDED MOUNTING PLATES FOR HARDWARE BY GATE FABRICATOR.

CONFIRM HARDWARE WITH GATE FABRICATOR PRIOR TO ORDERING.



Hardware Group No. 40 - PH, FIELD VERIFY ACTUAL DOOR SIZE

For use on Door #(s):

G-1                      G-7                      G-11                      G-12

Provide each PR door(s) with the following:

QTY	EA	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
	EA	GATE HINGES/PIVOTS (QUANTITY AS REQ)	BY GATE FABRICATOR		B/O
2	EA	HYDRAULIC GATE CLOSER	BY GATE FABRICATOR		B/O
1	EA	CENTER POST	BY GATE FABRICATOR		
1	EA	PANIC HARDWARE	LD-PA-AX-98-EO-WH	630	VON
1	EA	PANIC HARDWARE	LD-PA-AX-98-EO-WH	630	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-400-993R-70-MT-RHO-B 4AA BATTERY	626	SCE
1	EA	SFIC MORTISE CYL.	20-061 ICX (CAM AS REQ)	626	SCH
1	EA	PERMANENT SFIC CORE	MATCH DISTRICT STANDARD	626	BES
2	EA	KICK PLATE	PROVIDE 10" SMOOTH SURFACE ON PUSH SIDE	630	IVE
2	EA	FLOOR STOP	FS18S/L AS REQ	BLK	IVE
2	EA	DOOR CONTACT	679-05HM/WD AS REQ	BLK	SCE
1	EA	CARD READER	SUPPLIED BY DIV 28 COORDINATE W/ ACCESS CONTROL SUPPLIER		
1			BALANCE OF HARDWARE BY GATE FABRICATOR		

EXIT DEVICE TRIM SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT IS SPECIFIED AND SUPPLIED IN DIV 28

PIM TO BE PROVIDED BY DIV 28

FIELD VERIFY HARDWARE SPECIFIED WILL FIT IN EXISTING PREPS PRIOR TO ORDERING

WELDED MOUNTING PLATES FOR HARDWARE BY GATE FABRICATOR.

CONFIRM HARDWARE WITH GATE FABRICATOR PRIOR TO ORDERING.

Hardware Group No. 41

For use on Door #(s):

G-14                      G-15                      G-16

Provide each PR door(s) with the following:











QTY	EA	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1			HARDWARE BY GATE MANUFACTURER		

Hardware Group No. 42

For use on Door #(s):

111

Provide each PR door(s) with the following:







QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	SET	AUTO FLUSH BOLT	FB31P		630	IVE
1	EA	DUST PROOF STRIKE	DP1 OR DP2 AS REQ'D		626	IVE
1	EA	PASSAGE SET	L9010 06A		626	SCH
1	EA	COORDINATOR	COR X FL X MB		628	IVE
2	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	ASTRAGAL	383AA		AA	ZER

Hardware Group No. 43

For use on Door #(s):

112

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PASSAGE SET	L9010 06A		626	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	STOP	WS406/407CCV OR FS439 AS REQ		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

END OF SECTION 087100

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**SECTION 088000  
GLAZING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Insulating glass units.
- B. Glazing units.
- C. Plastic films.
- D. Glazing compounds.

**1.02 REFERENCE STANDARDS**

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015 (Reaffirmed 2020).
- C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers 2005 (Reapproved 2019).
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- E. ASTM C1036 - Standard Specification for Flat Glass 2021.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- G. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
- H. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass 2021a.
- I. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings 2016.
- J. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation 2019.
- K. GANA (GM) - GANA Glazing Manual 2008.
- L. GANA (SM) - GANA Sealant Manual 2008.
- M. GANA (LGRM) - Laminated Glazing Reference Manual 2019.
- N. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use 1990 (2016).
- O. NFRC 100 - Procedure for Determining Fenestration Product U-factors 2020.
- P. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence 2020.
- Q. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems 2020.

**1.03 SUBMITTALS**

- A. See Section 013000 - 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. Samples: Submit two samples 12 by 12 in size of glass units.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

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#### 1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

#### 1.05 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

#### 1.06 WARRANTY

- A. See Section 017800 - 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.
- C. Heat Soaked Tempered Glass: Provide a five (5) year manufacturer warranty to include coverage for spontaneous breakage of fully tempered glass caused by nickel sulfide (NiS) inclusions.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Float Glass Manufacturers:
  - 1. Vitro Architectural Glass (formerly PPG Glass): [www.vitroglazings.com/#sle](http://www.vitroglazings.com/#sle).
- B. Plastic Films Manufacturers:
  - 1. 3M Window Film: [solutions.3m.com/wps/portal/3M/en\\_US/Window\\_Film/Solutions/#sle](http://solutions.3m.com/wps/portal/3M/en_US/Window_Film/Solutions/#sle).

#### 2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
  - 1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
  - 2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
  - 3. Glass thicknesses listed are minimum.
- B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
  - 1. In conjunction with weather barrier related materials described in other sections, as follows:
- C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
  - 1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
  - 2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
  - 3. Solar Optical Properties: Comply with NFRC 300 test method.

#### 2.03 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.

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1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
4. Heat-Soak Testing (HST): Provide HST of fully tempered glass used on canopy, point-supported, spider wall, high-risk, sloping overhead, horizontal overhead, free-standing glass protective barrier, or other demanding applications of project, to reduce risks of spontaneous breakage due to nickel sulfide (NiS) induced fractures in accordance with industry established testing requirements.

## 2.04 INSULATING GLASS UNITS

- A. Manufacturers:
  1. Vitro Architectural Glass (formerly PPG Glass): [www.vitroglazings.com/#sle](http://www.vitroglazings.com/#sle).
- 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. Warm-Edge Spacers: Low-conductivity thermoplastic with dessicant warm-edge technology design.
    - a. Spacer Width: As required for specified insulating glass unit.
    - b. Spacer Height: Manufacturer's standard.
  4. Spacer Color: Black.
  5. Edge Seal:
    - a. Color: Black.
  6. Purge interpane space with dry air, hermetically sealed.
- C. Type IG-1 - Insulating Glass Units: Vision glass, double glazed.
  1. Applications: Exterior glazing unless otherwise indicated.
  2. Space between lites filled with air.
  3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
    - a. Tint: Clear.
    - b. Coating: Low-E (passive type), on #2 surface.
  4. Warm-edge spacer.
  5. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
    - a. Tint: Clear.
  6. Total Thickness: 1 inch.
  7. Thermal Transmittance (U-Value), Summer - Center of Glass: [\_\_\_\_], nominal.
  8. Visible Light Transmittance (VLT): [\_\_\_\_] percent, nominal.
  9. Solar Heat Gain Coefficient (SHGC): [\_\_\_\_], nominal.
- D. Type IG-5 - Insulating Glass Units: Safety glazing.
  1. Applications:
    - a. Glazed lites in exterior doors.
    - b. Glazed sidelights and panels next to doors.
    - c. Other locations required by applicable federal, state, and local codes and regulations.
  2. Space between lites filled with air.
  3. Glass Type: Same as Type [\_\_\_\_] except use fully tempered float glass for both outboard and inboard lites.
  4. Total Thickness: 1 inch.
  5. Thermal Transmittance (U-Value), Summer - Center of Glass: [\_\_\_\_], nominal.

## 2.05 GLAZING UNITS

- A. Type G-1 - Monolithic Exterior Vision Glazing:
  1. Applications: Exterior glazing unless otherwise indicated.

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2. Glass Type: Annealed float glass.
  3. Tint: Clear.
  4. Thickness: 1/4 inch, nominal.
- B. Type G-2 - Monolithic Interior Vision Glazing:
1. Applications: Interior glazing unless otherwise indicated.
  2. Glass Type: Annealed float glass.
  3. Tint: Clear.
  4. Thickness: 1/4 inch, nominal.
- C. Type G-3 - Monolithic Safety Glazing: Non-fire-rated.
1. Applications:
    - a. Glazed lites in doors, except fire doors.
    - b. Glazed sidelights to doors, except in fire-rated walls and partitions.
    - c. Glazed view windows and panels in partitions enclosing athletic activity rooms, except in fire-rated walls and partitions.
    - d. Other locations required by applicable federal, state, and local codes and regulations.
    - e. Other locations indicated on drawings.
  2. Glass Type: Fully tempered safety glass as specified.
  3. Tint: Clear.
  4. Thickness: 1/4 inch, nominal.

## 2.06 PLASTIC FILMS

- A. Type F-4 - Decorative Plastic Film: Polyester type.
1. Application: Locations and design as indicated on drawings.
  2. Manufacturers:
    - a. 3M.

## 2.07 GLAZING COMPOUNDS

- A. Type GC-1 - Glazing Putty: Polymer modified latex recommended by manufacturer for outdoor use, knife grade consistency; gray color.
- B. Type GC-5 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; [ ] color.
- C. Manufacturers:
1. Bostik Inc: [www.bostik-us.com/#sle](http://www.bostik-us.com/#sle).
  2. Dow Corning Corporation: [www.dowcorning.com/construction/#sle](http://www.dowcorning.com/construction/#sle). Dow Corning Corporation: [www.dowcorning.com/construction/#sle](http://www.dowcorning.com/construction/#sle).
  3. Master Builders Solutions: [www.master-builders-solutions.com/en-us/#sle](http://www.master-builders-solutions.com/en-us/#sle).
  4. Momentive Performance Materials, Inc: [www.momentive.com/#sle](http://www.momentive.com/#sle).
  5. Pecora Corporation: [www.pecora.com/#sle](http://www.pecora.com/#sle).
  6. Tremco Commercial Sealants & Waterproofing; Proglaze SSG: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
  7. [ ].
  8. Substitutions: See Section 016000 - Product Requirements.

## 2.08 ACCESSORIES

- A. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- B. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.

## PART 3 EXECUTION

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### 3.01 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that the minimum required face and edge clearances are being provided.
- C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- D. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

### 3.03 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- E. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

### 3.04 INSTALLATION - PLASTIC FILM

- A. Install plastic film with adhesive, applied in accordance with film manufacturer's instructions.
- B. Place without air bubbles, creases or visible distortion.
- C. Install film tight to perimeter of glass and carefully trim film with razor sharp knife. Provide 1/16 inch to 1/8 inch gap at perimeter of glazed panel unless otherwise required. Do not score the glass.

### 3.05 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.

### 3.06 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.

### 3.07 PROTECTION

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- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

**END OF SECTION**



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**SECTION 088813  
FIRE-RATED GLAZING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fire-rated glazing units.
- B. Glazing compounds.

**1.02 REFERENCE STANDARDS**

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.
- B. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers 2005 (Reapproved 2019).
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- D. ASTM C1036 - Standard Specification for Flat Glass 2021.
- E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
- G. GANA (GM) - GANA Glazing Manual 2008.
- H. GANA (SM) - GANA Sealant Manual 2008.
- I. GANA (LGRM) - Laminated Glazing Reference Manual 2019.
- J. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use 1990 (2016).
- L. ITS (DIR) - Directory of Listed Products Current Edition.
- M. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2022.
- N. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies 2022.
- O. UL (DIR) - Online Certifications Directory Current Edition.
- P. UL 9 - Standard for Fire Tests of Window Assemblies Current Edition, Including All Revisions.
- Q. UL 10B - Standard for Fire Tests of Door Assemblies Current Edition, Including All Revisions.
- R. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data on Glazing 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. Specimen warranty.

**1.04 QUALITY ASSURANCE**

- A. Perform work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

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- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

### 1.05 FIELD CONDITIONS

- A. Ambient Conditions: Do not install glazing when ambient temperature is less than 40 degrees F.
- B. Maintain minimum ambient temperature before, during, and 24 hours after installation of glazing compounds.

### 1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty for Insulating Glass Units: Provide five-year manufacturer warranty coverage for seal failure, interpane dusting or misting, including providing products to replace failed units, and commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.
- C. Manufacturer Warranty for Heat Soaked Tempered Glass: Provide five-year manufacturer warranty coverage for spontaneous breakage of fully tempered glass caused by nickel sulfide (NiS) inclusions, and commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Glass Fabricators:
1. GGI - General Glass International: [www.generalglass.com/#sle](http://www.generalglass.com/#sle).
  2. JE Berkowitz, LP: [www.jeberkowitz.com/#sle](http://www.jeberkowitz.com/#sle).
  3. Standard Bent Glass Corp: [www.standardbent.com/#sle](http://www.standardbent.com/#sle).
  4. Trulite Glass & Aluminum Solutions, LLC: [www.trulite.com/#sle](http://www.trulite.com/#sle).
  5. Viracon, Inc: [www.viracon.com/#sle](http://www.viracon.com/#sle).
- B. Float Glass Manufacturers:
1. AGC Glass North America, Inc: [www.agcglass.com/#sle](http://www.agcglass.com/#sle).
  2. Cardinal Glass Industries: [www.cardinalcorp.com/#sle](http://www.cardinalcorp.com/#sle).
  3. Guardian Glass, LLC: [www.guardianglass.com/#sle](http://www.guardianglass.com/#sle).
  4. Pilkington North America Inc: [www.pilkington.com/na/#sle](http://www.pilkington.com/na/#sle).
  5. Vitro Architectural Glass (formerly PPG Glass): [www.vitroglazings.com/#sle](http://www.vitroglazings.com/#sle).
- C. Fire-Resistance-Rated Glass:
1. Fabricators:
    - a. GGI - General Glass International; Pyrobel: [www.generalglass.com/#sle](http://www.generalglass.com/#sle).
  2. Manufacturers:
    - a. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite II-XL: [www.safti.com/#sle](http://www.safti.com/#sle).
    - b. Technical Glass Products; Pilkington Pyrostop: [www.fireglass.com/#sle](http://www.fireglass.com/#sle).
    - c. Vetrotech North America; Contraflam 60: [www.vetrotechusa.com/#sle](http://www.vetrotechusa.com/#sle).

### 2.02 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
  2. Kind FT - Fully Tempered Type: Comply with ASTM C1048.

### 2.03 GLAZING UNITS

- A. Type FPG-1 - Fire-Protection-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire rating period of 90 minutes or less.
1. Applications:
    - a. Glazing in fire-resistance-rated door assembly.

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- b. Glazing in fire-resistance-rated window assembly.
- c. Other locations as indicated on drawings.
- 2. Glass Type: Specialty tempered float glass.
- 3. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
- 4. Safety Glazing Certification: 16 CFR 1201 Category II.
- 5. Glazing Method: As required for fire rating.
- 6. Fire-Rating Period: As indicated on drawings.
- 7. Markings for Fire-Protection-Rated Glazing Assemblies: Provide permanent markings on fire-protection-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction
  - a. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
  - b. "OH" - meets fire window assembly criteria, including hose stream test of NFPA 257 or UL 9 fire test standards.
  - c. "H" - meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire tests standards.
  - d. "XXX" - placeholder that represents fire-rating period, in minutes.
- 8. Products:
  - a. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite X-45: [www.safti.com/#sle](http://www.safti.com/#sle).
  - b. SAFTIFIRST, a division of O'Keeffe's Inc; SuperClear 45-HS: [www.safti.com/#sle](http://www.safti.com/#sle).
  - c. Technical Glass Products; Firelite: [www.fireglass.com/#sle](http://www.fireglass.com/#sle).
  - d. Technical Glass Products; Firelite Plus: [www.fireglass.com/#sle](http://www.fireglass.com/#sle).
  - e. Technical Glass Products; Firelite NT: [www.fireglass.com/#sle](http://www.fireglass.com/#sle).
  - f. Vetrotech North America; Pyroswiss 45: [www.vetrotechusa.com/#sle](http://www.vetrotechusa.com/#sle).

#### 2.04 GLAZING COMPOUNDS

- A. Type GC-1 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.
  - 1. Manufacturers:
    - a. BASF Corporation: [www.basf.com/#sle](http://www.basf.com/#sle).
    - b. Bostik Inc: [www.bostik-us.com/#sle](http://www.bostik-us.com/#sle).
    - c. Dow Corning Corporation: [www.dowcorning.com/construction/#sle](http://www.dowcorning.com/construction/#sle).
    - d. Momentive Performance Materials, Inc: [www.momentive.com/#sle](http://www.momentive.com/#sle).
    - e. Pecora Corporation: [www.pecora.com/#sle](http://www.pecora.com/#sle).
    - f. Tremco Commercial Sealants & Waterproofing: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).

#### 2.05 ACCESSORIES

- A. Setting Blocks: Aluminum silicate, 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. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Continuous by one half the height of glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape: Closed-cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to affect air barrier and vapor retarder seal; [ ] by [ ] size.
- D. Glazing Tape: Flexible tape made from spun calcium-magnesium-silica fibers in binder; designed to remain stable at temperatures up to 2,012 degrees F.
  - 1. Thickness: As recommended by framing manufacturer for glazing application.
- E. Glazing Gaskets: Flexible intumescent seals.

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## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that minimum required face and edge clearances are provided.
- C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- D. Verify that sealing between joints of glass framing members has been completed effectively.
- E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

### **3.02 PREPARATION**

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

### **3.03 INSTALLATION - GENERAL**

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers unless more stringent requirements are indicated, including those in referenced glazing standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- F. Prevent glass from contact with contaminating substances that may result from construction operations including, but not limited to weld spatter, fire-safing, plastering, mortar droppings, etc.

### **3.04 FIELD QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- C. Manufacturer Services: Provide services of glass and glazing manufacturer's field representative to observe installation of their products.

### **3.05 CLEANING**

- A. See Section 017000 - Execution and Closeout Requirements for additional requirements.
- B. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- C. Remove nonpermanent labels immediately after glazing installation is complete.
- D. Clean glass and adjacent surfaces after sealants are fully cured.
- E. Clean glass on both exposed surfaces not more than four days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

### **3.06 PROTECTION**

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- A. After installation, mark pane with 'X' by using removable plastic tape or paste; do not mark heat-absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

**END OF SECTION**

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## SECTION 089100 LOUVERS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Louvers, frames, and accessories.

#### 1.02 RELATED REQUIREMENTS

- A. Section 233100 - HVAC Ducts and Casings: Ductwork attachment to louvers, and blank-off panels.

#### 1.03 REFERENCE STANDARDS

- A. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices 2021.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

#### 1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
- C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.
- D. Samples: Submit two samples 2 by 2 inches in size illustrating finish and color of exterior and interior surfaces.
- E. Test Reports: Independent agency reports showing compliance with specified performance criteria.

#### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

#### 1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
  - 1. Finish: Include twenty year coverage against degradation of exterior finish.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Louvers:
  - 1. Airline Louvers: [www.airlinelouvers.com/#sle](http://www.airlinelouvers.com/#sle).
  - 2. Airolite Company, LLC: [www.airolite.com/#sle](http://www.airolite.com/#sle).
  - 3. American Warming and Ventilating: [www.awv.com/#sle](http://www.awv.com/#sle).
  - 4. Construction Specialties, Inc: [www.c-sgroup.com/#sle](http://www.c-sgroup.com/#sle).
  - 5. Industrial Louvers, Inc: [www.industriallouvers.com/#sle](http://www.industriallouvers.com/#sle).
  - 6. NCA, a brand of Metal Industries Inc: [www.ncamfg.com/#sle](http://www.ncamfg.com/#sle).
  - 7. Pottorff: [www.pottorff.com/#sle](http://www.pottorff.com/#sle).

#### 2.02 LOUVERS

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

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1. Manufacturers:
- B. Stationary Louvers: Horizontal blade, formed galvanized steel sheet construction, with intermediate mullions matching frame.
  1. Free Area: 50 percent, minimum.
  2. Blades: Straight.
  3. Frame: 4 inches deep, channel profile; corner joints mitered and , with continuous recessed caulking channel each side.
  4. Steel Thickness, Galvanized: Frame 16 gage, 0.0598 inch minimum base metal; blades 16 gage, 0.0598 inch minimum base metal.
  5. Steel Finish: Primed, finished after fabrication.

### **2.03 MATERIALS**

- A. Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

### **2.04 FINISHES**

- A. Primer: Zinc chromate, alkyd type.

### **2.05 ACCESSORIES**

- A. Fasteners and Anchors: Galvanized steel.
- B. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.
- B. Verify that field measurements are as indicated.

### **3.02 INSTALLATION**

- 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.

### **3.03 CLEANING**

- A. Strip protective finish coverings.
- B. Clean surfaces and components.

**END OF SECTION**

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**SECTION 090561  
COMMON WORK RESULTS FOR FLOORING PREPARATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
  - 1. Resilient tile and sheet.
  - 2. Carpet tile.
  - 3. Thin-set ceramic tile and stone tile.
- B. Removal of existing floor coverings.
- C. Preparation of new and existing concrete floor slabs for installation of floor coverings.
- D. Testing of concrete floor slabs for moisture and alkalinity (pH).
- E. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
  - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- F. Patching compound.
- G. Remedial floor coatings.
- H. Preparation of new and existing wood-based floors and subfloors for installation of new floor coverings.

**1.02 REFERENCE STANDARDS**

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens) 2021.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete 2020.
- C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride 2022.
- D. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings 2011.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

**1.04 SUBMITTALS**

- A. Visual Observation Report: For existing floor coverings to be removed.
- B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
  - 1. Moisture and alkalinity (pH) limits and test methods.
  - 2. Manufacturer's required bond/compatibility test procedure.
- C. Testing Agency's Report:
  - 1. Description of areas tested; include floor plans and photographs if helpful.
  - 2. Summary of conditions encountered.
  - 3. Moisture and alkalinity (pH) test reports.
  - 4. Copies of specified test methods.
  - 5. Recommendations for remediation of unsatisfactory surfaces.
  - 6. Product data for recommended remedial coating.
  - 7. Submit report directly to Owner.
  - 8. Submit report not more than two business days after conclusion of testing.



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- D. Adhesive Bond and Compatibility Test Report.
- E. Copy of RFCI (RWP).

**1.05 QUALITY ASSURANCE**

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
  - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
  - 1. Provide access for and cooperate with testing agency.
  - 2. Confirm date of start of testing at least 10 days prior to actual start.
  - 3. Allow at least 4 business days on site for testing agency activities.
  - 4. Achieve and maintain specified ambient conditions.
  - 5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

**1.07 FIELD CONDITIONS**

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
  - 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
  - 2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
  - 3. Products:
    - a. ARDEX Engineered Cements; ARDEX Feather Finish:  
[www.ardexamericas.com/#sle](http://www.ardexamericas.com/#sle).
    - b. TEC, an H.B. Fuller Construction Products Brand; TEC Feather Edge Skim Coat:  
[www.tecspecialty.com/#sle](http://www.tecspecialty.com/#sle).
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for

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adhesion of flooring without further treatment.

1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
2. Use product recommended by testing agency.
3. Products:
  - a. ARDEX Engineered Cements; ARDEX MC RAPID: [www.ardexamericas.com/#sle](http://www.ardexamericas.com/#sle).
  - b. Custom Building Products; TechMVC Moisture Vapor and Alkalinity Barrier: [www.custombuildingproducts.com/#sle](http://www.custombuildingproducts.com/#sle).
  - c. Floor Seal Technology, Inc; MES 100 with Floor Seal FloorCem SLU: [www.floorseal.com/#sle](http://www.floorseal.com/#sle).
  - d. Koster American Corporation; Koster VAP I 2000 with Koster SL Premium overlay: [www.kosterusa.com/#sle](http://www.kosterusa.com/#sle).
  - e. LATICRETE International, Inc; LATICRETE DRYTEK Moisture Vapor Barrier with LATICRETE DRYTEK Skimcoat: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
  - f. LATICRETE International, Inc; LATICRETE NXT Vapor Reduction Coating with LATICRETE NXT Level Plus: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
  - g. LATICRETE International, Inc; LATICRETE SUPERCAP Moisture Vapor Control with LATICRETE SUPERCAP Underlayment: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
  - h. Maxxon Corporation; Aquafin SG2: [www.maxxon.com/#sle](http://www.maxxon.com/#sle).
  - i. Proflex Products, Inc; Moisture Barrier 25 with DPU - Deep Pour Underlayment: [www.proflex.us/#sle](http://www.proflex.us/#sle).
  - j. Sika Corporation; Sikafloor Moisture Tolerance Epoxy Primer and Sikafloor Self-Leveling Moisture Tolerant Resurfacer: [www.sikafloorusa.com/#sle](http://www.sikafloorusa.com/#sle).
  - k. Stauf USA, LLC; ERP-270 Perma-Seal: [www.staufusa.com/#sle](http://www.staufusa.com/#sle).
  - l. TEC, an H.B. Fuller Construction Products Brand; TEC LiquiDam EZ with TEC Level Set 200 SLU: [www.tecspecialty.com/#sle](http://www.tecspecialty.com/#sle).
  - m. Tnemec Company, Inc; Series 208 Epoxoprime MVT: [www.tnemec.com/#sle](http://www.tnemec.com/#sle).
  - n. UZIN, a division of UFLOOR Systems Inc; UZIN PE 460 with UZIN PE 280 and UZIN NC 170 LevelStar: [www.ufloorsystems.com/#sle](http://www.ufloorsystems.com/#sle).

## **PART 3 EXECUTION**

### **3.01 CONCRETE SLAB PREPARATION**

- A. Follow recommendations of testing agency.
- B. Perform following operations in the order indicated:
  1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
    - a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
    - b. Removal of existing floor covering.
  2. Preliminary cleaning.
  3. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
  4. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
  5. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
  6. Specified remediation, if required.
  7. Patching, smoothing, and leveling, as required.
  8. Other preparation specified.
  9. Adhesive bond and compatibility test.
  10. Protection.
- C. Remediations:

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1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

### **3.02 REMOVAL OF EXISTING FLOOR COVERINGS**

- A. Comply with local, State, and federal regulations and recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to floor covering being removed.
- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

### **3.03 PRELIMINARY CLEANING**

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

### **3.04 MOISTURE VAPOR EMISSION TESTING**

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

### **3.05 ALKALINITY TESTING**

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
- C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
- D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

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### **3.06 PREPARATION**

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with recommendations of testing agency.
- C. Comply with requirements and recommendations of floor covering manufacturer.
- D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- E. Do not fill expansion joints, isolation joints, or other moving joints.

### **3.07 ADHESIVE BOND AND COMPATIBILITY TESTING**

- A. Comply with requirements and recommendations of floor covering manufacturer.

### **3.08 APPLICATION OF REMEDIAL FLOOR COATING**

- A. Comply with requirements and recommendations of coating manufacturer.

### **3.09 PROTECTION**

- A. Cover prepared floors with building paper or other durable covering.

**END OF SECTION**

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**SECTION 092116  
GYPSUM BOARD ASSEMBLIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Metal stud wall framing.
- B. Metal channel ceiling framing.
- C. Acoustic insulation.
- D. Gypsum wallboard.
- E. Joint treatment and accessories.
- F. Textured finish system.

**1.02 REFERENCE STANDARDS**

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- C. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members 2015.
- D. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017 (Reapproved 2022).
- E. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing 2003 (Reapproved 2017).
- F. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.
- G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.
- H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.
- I. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base 2019.
- J. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel 2017.
- K. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.
- L. GA-216 - Application and Finishing of Gypsum Panel Products 2021.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
- C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- E. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.
- F. Test Reports: Bullet resistant sheathing and wallboard.

**1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with a minimum of 5 years of experience.

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- B. Copies of Documents at Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

## **PART 2 PRODUCTS**

### **2.01 GYPSUM BOARD ASSEMBLIES**

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
1. See PART 3 for finishing requirements.

### **2.02 METAL FRAMING MATERIALS**

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
1. ClarkDietrich: [www.clarkdietrich.com/#sle](http://www.clarkdietrich.com/#sle).
  2. Jaimes Industries: [www.jaimesind.com/#sle](http://www.jaimesind.com/#sle).
  3. Marino: [www.marinoware.com/#sle](http://www.marinoware.com/#sle).
  4. R-stud, LLC: [www.rstud.com/#sle](http://www.rstud.com/#sle).
  5. Phillips Manufacturing Co: [www.phillipsmfg.com/#sle](http://www.phillipsmfg.com/#sle).
  6. SCAFCO Corporation: [www.scafco.com/#sle](http://www.scafco.com/#sle).
  7. Steel Construction Systems: [www.steelconsystems.com/#sle](http://www.steelconsystems.com/#sle).
- B. 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.
- C. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.
- D. Non-Loadbearing Framing Accessories:
1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
  2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
    - a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
  3. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

### **2.03 BOARD MATERIALS**

- A. Manufacturers - Gypsum-Based Board:
1. American Gypsum Company: [www.americangypsum.com/#sle](http://www.americangypsum.com/#sle).
  2. CertainTeed Corporation: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
  3. Continental Building Products: [www.continental-bp.com/#sle](http://www.continental-bp.com/#sle).
  4. Georgia-Pacific Gypsum: [www.gpgypsum.com/#sle](http://www.gpgypsum.com/#sle).
  5. Lafarge North America Inc: [www.lafargenorthamerica.com](http://www.lafargenorthamerica.com).
  6. National Gypsum Company: [www.nationalgypsum.com/#sle](http://www.nationalgypsum.com/#sle).
  7. PABCO Gypsum: [www.pabco gypsum.com/#sle](http://www.pabco gypsum.com/#sle).
  8. 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. Unfaced fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
  3. Thickness:
    - a. Vertical Surfaces: 5/8 inch.

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- b. Ceilings: 1/2 inch.
- 4. Paper-Faced Products:
  - a. American Gypsum Company; LightRoc Gypsum Wallboard.
  - b. American Gypsum Company; FireBloc Type X Gypsum Wallboard.
  - c. American Gypsum Company; FireBloc Type C Gypsum Wallboard.
  - d. CertainTeed Corporation; Type C Drywall.
  - e. CertainTeed Corporation; Type X Drywall.
  - f. Continental Building Products; Firecheck Type C.
  - g. Continental Building Products; Firecheck Type X.
  - h. Continental Building Products; LiftLite.
  - i. Continental Building Products; LiftLite Firecheck 30.
  - j. Continental Building Products; Regular Drywall.
  - k. Georgia-Pacific Gypsum; ToughRock.
  - l. Georgia-Pacific Gypsum; ToughRock Fireguard X.
  - m. Georgia-Pacific Gypsum; ToughRock Fireguard C.
  - n. National Gypsum Company; Gold Bond BRAND Fire-Shield Gypsum Board.
  - o. National Gypsum Company; Gold Bond 3/4" Ultra-Shield FS Gypsum Board.
- C. 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. Thickness: 1/2 inch.
  - 3. Edges: Tapered.
  - 4. Products:
    - a. CertainTeed Corporation; Interior Ceiling Drywall.
    - b. Continental Building Products; Sagcheck.
    - c. Georgia-Pacific Gypsum; ToughRock Span 24 Ceiling Board.

#### 2.04 ACCESSORIES

- A. 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.
  - 2. Splayed Corner Beads: as indicated on plans.
  - 3. Architectural Reveal Beads:
    - a. Reveal Width: 3/8"
- B. Decorative Metal Trim:
  - 1. Material: Extruded aluminum alloy 6063-T5 temper.
  - 2. Finish: Anodized, clear.
  - 3. Type: Profile as selected from manufacturer's standard range.
  - 4. Corner Trim:
    - a. Products:
      - 1) Tamlyn; XtremeInterior Corner Trim: [www.xtremeias.com/#sle](http://www.xtremeias.com/#sle).
  - 5. Reveal Trim:
    - a. Products:
      - 1) Tamlyn; XtremeInterior Reveal Trim: [www.xtremeias.com/#sle](http://www.xtremeias.com/#sle).
- C. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
  - 1. Joint Compound: Drying type, vinyl-based, ready-mixed.
    - a. Products:
      - 1) CertainTeed Corporation; Extreme All-Purpose Joint Compound: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
      - 2) Continental Building Products: [www.continental-bp.com/#sle](http://www.continental-bp.com/#sle).

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- D. High Build Drywall Surfer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
- E. 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.
- F. 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.
- G. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
- H. Adhesive for Attachment to Metal:
  - 1. Products:
    - a. Franklin International, Inc; Titebond PROvantage Professional Drywall Adhesive: [www.titebond.com/#sle](http://www.titebond.com/#sle).
    - b. Liquid Nails, a brand of PPG Architectural Coatings; DWP-24 Drywall Construction Adhesive: [www.liquidnails.com/#sle](http://www.liquidnails.com/#sle).

### **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. 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.
  - 3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.
  - 4. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- C. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- D. Blocking: Install mechanically fastened steel channel blocking for support of:
  - 1. Framed openings.
  - 2. Wall mounted cabinets.

#### **3.03 BOARD INSTALLATION**

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

#### **3.04 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.
- B. Corner Beads: Install at external corners, using longest practical lengths.



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- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.
- D. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.

### 3.05 JOINT TREATMENT

- A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  - 1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
  - 2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  - 3. Level 3: Walls to receive textured wall finish.
  - 4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
  - 5. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- C. 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.
  - 2. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
  - 3. Taping, filling and sanding is not required at base layer of double layer applications.
- D. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
- E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

### 3.06 TOLERANCES

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

**END OF SECTION**

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**SECTION 092216  
NON-STRUCTURAL METAL FRAMING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Metal partition, ceiling, and soffit framing.
- B. Framing accessories.

**1.02 REFERENCE STANDARDS**

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- B. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.
- C. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.
- D. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2022.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
  - 2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
- C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.

**1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Metal Framing, Connectors, and Accessories:
  - 1. CEMCO: [www.cemcosteel.com/#sle](http://www.cemcosteel.com/#sle).
  - 2. ClarkDietrich: [www.clarkdietrich.com/#sle](http://www.clarkdietrich.com/#sle).
  - 3. Jaimes Industries: [www.jaimesind.com/#sle](http://www.jaimesind.com/#sle).
  - 4. Marino: [www.marinoware.com/#sle](http://www.marinoware.com/#sle).
  - 5. R-stud, LLC: [www.rstud.com/#sle](http://www.rstud.com/#sle).
  - 6. SCAFco Corporation: [www.scafco.com/#sle](http://www.scafco.com/#sle).
  - 7. Simpson Strong Tie: [www.strongtie.com/#sle](http://www.strongtie.com/#sle).
  - 8. Steel Construction Systems: [www.steelconsystems.com/#sle](http://www.steelconsystems.com/#sle).
  - 9. The Steel Network, Inc: [www.SteelNetwork.com/#sle](http://www.SteelNetwork.com/#sle).
  - 10. Substitutions: See Section 016000 - Product Requirements.

**2.02 FRAMING MATERIALS**

- A. Fire Rated Assemblies: Comply with applicable code and as indicated on drawings.
- B. 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/240 at 5 psf.
  - 1. Studs: C shaped with flat or formed webs with knurled faces.
  - 2. Runners: U shaped, sized to match studs.

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3. Ceiling Channels: C shaped.
- C. Non-Loadbearing Framing Accessories:
  1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
  2. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.
  3. Fasteners: ASTM C1002 self-piercing tapping screws.
  4. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced.

### **2.03 FABRICATION**

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.
- C. Fit and assemble in largest practical sections for delivery to site, ready for installation.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.

### **3.02 INSTALLATION OF STUD FRAMING**

- A. Comply with requirements of ASTM C754.
- B. Comply with requirements of CBC Section 1614A and Section 2504.2.
- C. Extend partition framing to structure where indicated and to ceiling in other locations.
- D. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.
- E. Blocking: Use steel channels secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and opening frames.

### **3.03 CEILING AND SOFFIT FRAMING**

- A. Comply with requirements of ASTM C754.
- B. Comply with requirements of CBC Section 1614A.
- C. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

### **3.04 TOLERANCES**

- A. Maximum Variation From True Position: 1/8 inch in 10 feet.
- B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

**END OF SECTION**

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**SECTION 092236  
LATH**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Metal lath for cement plaster.
- B. Furring for metal lath.
- C. Metal ceiling framing.
- D. Access panels.

**1.02 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on furring and lathing components, structural characteristics, material limitations, and finish.

**1.03 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Metal Lath and Accessories:
  - 1. Structa Wire Corp.: [www.structawire.com](http://www.structawire.com) (Basis of Design).
  - 2. Substitutions: See Section 016000 - Product Requirements.

**2.02 FRAMING MATERIALS**

- A. Furring Channels: Formed steel, minimum 0.020 inch thick, 3/8 inch deep by 7/8 inch high, splicing permitted; galvanized.
- B. Main Ceiling Channels: Formed steel, asphalt coated, minimum 0.05 inch thick, 3/4 inch deep by 1-1/2 inch high, single piece, no splicing; galvanized.
- C. Resilient Channels: Formed steel, minimum 0.020 inch thick; serrated face, flattened Z profile, [ ] inch wide, splicing permitted; galvanized.
- D. Hangers: Steel wire, of size and type to suit application, to support ceiling components in place to deflection limits as indicated.
- E. Ceiling Hangers: Rolled steel sections, of size and type to suit application, to rigidly support ceiling components in place to deflection limits as indicated; galvanized.
- F. Lateral Bracing: Formed steel, minimum 0.060 inch thick, size and length as required; galvanized.

**2.03 LATH**

- A. Wire Lath - ASTM C 933, Class 1 Galvanized Coating complying with ASTM A 641:
  - 1. Structa Welded Wire Lath:
    - a. Structa Mega Lath (Heavy Duty Reinforcing for commercial and institutional construction):
      - 1) Weight 1.95 lb/yd<sup>2</sup> (1.1 kg/sq.m)
      - 2) Finish - Class 1 Galvanized Coating complying with ASTM A641
      - 3) Alternate lath to 3.4 lb/yd<sup>2</sup> diamond mesh metal lath specified in ASTM C847
      - 4) As per IAPMO - UES 2017
    - b. V Truss Wall & Ceiling - Rib Lath (For soffits and open frame ceilings):
      - 1) Weight 2.2 lb/yd<sup>2</sup> (1.2 kg/sq.m)
      - 2) Finish - Class 1 Galvanized Coating complying with ASTM A641
      - 3) Alternate lath to 3.4 lb/yd<sup>2</sup> rib metal lath specified in ASTM C847

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- 4) As per IAPMO - UES 2017
- c. V Truss Corners - Exterior Corner Reinforcements:
  - 1) Available in Straight, Bullnose, Arch & One Coat profiles
  - 2) Finish - Class 1 Galvanized Coating complying with ASTM A641
  - 3) As per IAPMO - UES 2017
- B. Beads, Screeds, Joint Accessories, and Other Trim: Depth governed by plaster thickness, and maximum possible lengths.
  - 1. Material: Formed zinc, expanded metal flanges.
  - 2. Casing Beads with Weep Holes: Square edges.
    - a. Product: CDB Casing Drip Bead manufactured by Stockton Products.
  - 3. Corner Beads: Radiused corners.
    - a. Product: CA CornerAid, CRT CornerRite manufactured by Stockton Products.
  - 4. Base Screeds: Bevelled edges.
    - a. Product: OWS Offset Weep Screed manufactured by Stockton Products.
  - 5. Expansion Joints: Two-piece sliding type with reveal, 2 inch wide flanges.
    - a. Product: OWC Offset Water-Resistant Expansion Channel manufactured by Stockton Products.
  - 6. Control Joints: Accordion profile with factory-installed protective tape, 2 inch flanges.
    - a. Product: NVS Narrow V-Screed manufactured by Stockton Products.
  - 7. Soffit Vents:
    - a. Product: Metal-SVR manufactured by Stockton Products.
  - 8. Reveal Moldings: Aluminum extruded alloy 6063 TS with chemical conversion coating, clear anodized:
    - a. Product: Profile as shown on drawings manufactured by Fry Reglet.

#### **2.04 ACCESSORIES**

- A. Access Panels: As specified in Section 083100.
- B. Anchorage: Tie wire, nails, and other metal supports, of type and size to suit application; to rigidly secure materials in place, galvanized.
- C. Fasteners: Self-piercing tapping screws; ASTM C1002 or ASTM C954.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that substrates are ready to receive work and conditions are suitable for application.
- C. For exterior plaster and stucco on stud walls, verify that water-resistive barrier has been installed over sheathing substrate completely and correctly.
- D. Do not begin until unacceptable conditions have been corrected.
- E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### **3.02 INSTALLATION - GENERAL**

- A. Install metal lath and furring for Portland cement plaster in accordance with ASTM C1063.
- B. Install lath and furring for fire-rated assemblies in accordance with requirements of assembly as indicated.

#### **3.03 WALL FURRING INSTALLATION**

- A. Install furring channels horizontally; secure with fasteners on alternate channel flanges at maximum 24 inches on center.
- B. Space furring channels maximum 16 inches on center, and not more than 4 inches away from floor and ceiling lines.

#### **3.04 CEILING AND SOFFIT FRAMING AND FURRING INSTALLATION**

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- A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- B. Install furring independent of walls, columns, and above-ceiling work.
- C. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- D. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.
- E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- F. Install furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.
- G. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.
- H. Laterally brace suspension system.

### **3.05 CONTROL AND EXPANSION JOINT INSTALLATION**

- A. Locate joints as indicated on drawings and comply with ASTM C1063.
  - 1. Area of plaster panel not to exceed 144 sq ft for vertical surfaces.
  - 2. Area of plaster panel not to exceed 100 sq ft for horizontal, curved or angled surfaces.
  - 3. Spacing between control joints not to exceed 18 ft in each direction.
  - 4. Area bounded by control joints not to exceed a length-to-width ratio of 2-1/2 to 1.
- B. Install prefabricated joint accessories in accordance with ASTM C1063.

### **3.06 ACCESS PANELS INSTALLATION**

### **3.07 LATH INSTALLATION**

- A. Attach metal lath to metal supports using [ ] at maximum 6 inches on center.
- B. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches from corner to form the angle reinforcement; fasten at perimeter edges only.
- C. Place corner bead at external wall corners; fasten at outer edges of lath only.
- D. Place base screeds at termination of plaster areas; secure rigidly in place.
- E. Place lath vertically above each top corner and each side of door frames to 6 inches above ceiling line.
- F. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.
- G. Place additional strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

### **3.08 TOLERANCES**

- A. Maximum Variation from True Lines and Levels: 1/8 inch in 10 feet.
- B. Maximum Variation from True Position: 1/8 inch.

**END OF SECTION**

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**SECTION 092400  
CEMENT PLASTERING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Cement plastering.

**1.02 REFERENCE STANDARDS**

- A. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster 2022b.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittals procedures.
- B. Product Data: Provide data on plaster materials and trim accessories.

**1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

**1.05 FIELD CONDITIONS**

- A. Exterior Plaster Work: Do not apply plaster when substrate or ambient air temperature is 40 degrees F or lower, or when temperature is expected to drop below 40 degrees F within 48 hours of application.

**PART 2 PRODUCTS**

**2.01 CEMENT PLASTER APPLICATIONS**

- A. Lath Plaster Base: Metal lath.
  1. Plaster Type: Factory prepared plaster mix.
  2. Number of Coats: One.
  3. First Coat: Apply to a nominal thickness of 3/8 inch.
  4. Second Coat: Apply to a nominal thickness of 3/8 inch.
  5. Leveling Coat: Apply to a nominal thickness of 1/32 to 1/16 inch.
  6. Finish Coat: Apply to a nominal thickness of 1/8 inch.
- B. Solid Plaster Base: Precast concrete.
  1. Plaster Type: Jobsite mixed plaster.
  2. Number of Coats: One.
  3. First Coat: Apply to a nominal thickness of 1/4 inch.
  4. Second Coat: Apply to a nominal thickness of 1/4 inch.
  5. Leveling Coat: Apply to a nominal thickness of 1/32 to 1/16 inch.
  6. Finish Coat: Apply to a nominal thickness of 1/8 inch.

**2.02 FACTORY PREPARED CEMENT PLASTER**

**2.03 -----**

- A. Exterior Portland cement plaster system made of scratch and brown base coat, leveling coat with reinforcing mesh, and acrylic finish coat; install in accordance with ASTM C926.
  1. Provide weather resistive barrier as part of the system.
  2. Manufacturer - Basis of Design:
    - a. LaHabra; FastWall 300: [www.lahabrastucco.com/#sle](http://www.lahabrastucco.com/#sle).
    - b. Parex USA, Inc; Armourwall 300: [www.parexusa.com/#sle](http://www.parexusa.com/#sle).
- B. Premixed Finish Coating: Same product as base coat.

**2.04 ACCESSORIES**

- A. Lath: As specified in Section 092236.
- B. Beads, Screeds, and Joint Accessories: As specified in Section 092236.
- C. Reinforcing Mesh: 4.5 oz/sq yd alkali-resistant mesh.

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## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify masonry joints are flush and surfaces are ready to receive work of this section, and that there are no existing bituminous or water repellent coatings on masonry surfaces.
- C. Verify concrete surfaces are flat, honeycombs are filled flush, and surfaces are ready to receive work of this section, and that there are no existing bituminous, water repellent, or form release agent coatings on concrete surfaces that may be detrimental to plaster bond.
- D. Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are properly in place.
- E. Verify mechanical and electrical equipment and services located within areas to receive this work have been properly tested and approved.

### **3.02 PREPARATION**

- A. Dampen masonry surfaces to reduce excessive suction.
- B. Clean concrete surfaces of foreign matter using approved acid solutions, solvents, or detergents, and then rinse surfaces thoroughly with clean water.
- C. Roughen smooth concrete surfaces and apply bonding compound in accordance with manufacturer's written installation instructions.
- D. Apply dash bond coat of plaster to solid bases and moist cure for at least 24 hours before applying first coat of jobsite mixed plaster.

### **3.03 MIXING**

- A. Mix only as much plaster as can be used prior to initial set.
- B. Mix materials dry, to uniform color and consistency, before adding water.
- C. Do not retemper mixes after initial set has occurred.
- D. Protect mixtures from frost or freezing temperatures, contamination, and excessive evaporation.

### **3.04 APPLICATION**

- A. Apply plaster in accordance with manufacturer's written instructions and comply with ASTM C926.
- B. Base Coats:
  - 1. Apply base coat(s) to fully embed lath and to specified thickness.
  - 2. Follow guidelines in ASTM C926 and manufacturer's written installation instructions for moist curing base coats and application of subsequent coats.
- C. Leveling Coat:
  - 1. Apply leveling coat to specified thickness.
  - 2. Fully embed reinforcing mesh in leveling coat.
- D. Finish Coats:
  - 1. Cement Plaster:
    - a. Apply with sufficient material and pressure to ensure complete coverage of base to specified thickness.
    - b. Apply desired surface texture while mix is still workable.
    - c. Smooth trowel to a consistent finish.

### **3.05 TOLERANCES**

- A. Maximum Variation from True Flatness: 1/4 inch in 10 feet.

### **3.06 REPAIR**



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- A. Patching: Remove loose, damaged or defective plaster and replace with plaster of same composition; finish to match surrounding area.

**END OF SECTION**

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**SECTION 093000  
TILING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Cementitious backer board as tile substrate.
- D. Ceramic accessories.
- E. Ceramic trim.

**1.02 REFERENCE STANDARDS**

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium) 2019.
- B. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units 2018.
- C. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive 2021.
- D. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units 2019.
- E. ANSI A137.1 - American National Standard Specifications for Ceramic Tile 2022.
- F. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation 2022.

**1.03 ADMINISTRATIVE REQUIREMENTS**

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

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.
- E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

**1.05 QUALITY ASSURANCE**

- A. Maintain one copy of and ANSI A108/A118/A136 and TCNA (HB) on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- C. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.
- D. Ceramic tile flooring shall be stable, firm, and slip resistant. CBC Section 11B-302.1

**1.06 MOCK-UP**

- A. See Section 014000 - Quality Requirements, for general requirements for mock-up.

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- B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
  - 1. Minimum size of mock-up is indicated on drawings.
  - 2. Approved mock-up may remain as part of the Work.

### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

### 1.08 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

## PART 2 PRODUCTS

### 2.01 TILE

- A. Manufacturers: All products by the same manufacturer.
  - 1. Dal-Tile Corporation: [www.daltile.com/#sle](http://www.daltile.com/#sle).
- B. Ceramic Mosaic Tile: ANSI A137.1 standard grade.
  - 1. Shape: Rectangle.
  - 2. Edges: Square.
  - 3. Surface Finish: Matte glazed.
  - 4. Color(s): As indicated on drawings.
  - 5. Trim Units: Matching bead, cove, and surface bullnose shapes in sizes coordinated with field tile.
- C. Porcelain Tile: ANSI A137.1 standard grade.
  - 1. Edges: Square.
  - 2. Color(s): As indicated on drawings.
  - 3. Trim Units: Matching bullnose, double bullnose, cove base, and cove shapes in sizes coordinated with field tile.

### 2.02 TRIM AND ACCESSORIES

- A. Ceramic Accessories: Glazed finish, same color and finish as adjacent field tile; same manufacturer as tile.
- B. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
  - 1. Applications:
    - a. Open Edges: Bullnose.
    - b. Inside Corners: Jointed.
    - c. Floor to Wall Joints: Cove base.
  - 2. Manufacturers: Same as for tile.
- C. Solid Surface Thresholds: Proprietary homogenous sheet material composed of acrylic resins, fire retardant filler materials, and coloring agents; honed finish; 2 inches wide by full width of wall or frame opening; 1/2 inch thick; beveled one long edge with radiused corners on top side; without holes, cracks, or open seams; color and pattern as indicated.
  - 1. Products:
    - a. Dupont; Corian and Zodiac.
  - 2. Applications: Provide at the following locations:

### 2.03 SETTING MATERIALS

- A. Manufacturers:
  - 1. ARDEX Engineered Cements: [www.ardexamericas.com/#sle](http://www.ardexamericas.com/#sle).
  - 2. Bostik Inc: [www.bostik-us.com/#sle](http://www.bostik-us.com/#sle).
  - 3. Custom Building Products: [www.custombuildingproducts.com/#sle](http://www.custombuildingproducts.com/#sle).

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4. LATICRETE International, Inc: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
  5. Merkrete, by Parex USA, Inc: [www.merkrete.com/#sle](http://www.merkrete.com/#sle).
  6. TEC, an H.B. Fuller Construction Products Brand: [www.tecspecialty.com/#sle](http://www.tecspecialty.com/#sle).
- B. Mortar Bed Materials: Pre-packaged mix of Portland cement, sand, latex additive, and water.
1. Products:
    - a. ARDEX Engineered Cements; A 38: [www.ardexamericas.com/#sle](http://www.ardexamericas.com/#sle).
    - b. LATICRETE International, Inc; LATICRETE 3701 Fortified Mortar Bed: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
    - c. Merkrete, by Parex USA, Inc; Merkrete Underlay C: [www.merkrete.com/#sle](http://www.merkrete.com/#sle).
    - d. Proflex Products, Inc; MSI - Mud Set Installation: [www.proflex.us/#sle](http://www.proflex.us/#sle).

## 2.04 GROUTS

- A. Manufacturers:
1. ARDEX Engineered Cements: [www.ardexamericas.com/#sle](http://www.ardexamericas.com/#sle).
  2. Bostik Inc: [www.bostik-us.com/#sle](http://www.bostik-us.com/#sle).
  3. Custom Building Products: [www.custombuildingproducts.com/#sle](http://www.custombuildingproducts.com/#sle).
  4. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
  5. Merkrete, by Parex USA, Inc; Merkrete Duracolor Non-Sanded Color Grout: [www.merkrete.com/#sle](http://www.merkrete.com/#sle).
  6. TEC, an H.B. Fuller Construction Products Brand: [www.tecspecialty.com/#sle](http://www.tecspecialty.com/#sle).
- B. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
1. Color(s): As selected by Architect from manufacturer's full line.
  2. Products:
    - a. ARDEX Engineered Cements; ARDEX WA: [www.ardexamericas.com/#sle](http://www.ardexamericas.com/#sle).
    - b. Custom Building Products; CEG-IG 100% Solids Industrial Grade Epoxy Grout: [www.custombuildingproducts.com/#sle](http://www.custombuildingproducts.com/#sle).
    - c. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
    - d. Merkrete, by Parex USA, Inc; Merkrete Pro Epoxy: [www.merkrete.com/#sle](http://www.merkrete.com/#sle).
    - e. Stuart Dean Company, Inc; Marcoat GS: [www.stuartdean.com/#sle](http://www.stuartdean.com/#sle).
    - f. TEC, an H.B. Fuller Construction Products Brand; TEC AccuColor EFX Epoxy Special Effects Grout: [www.tecspecialty.com/#sle](http://www.tecspecialty.com/#sle).

## 2.05 MAINTENANCE MATERIALS

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
1. Applications: Between tile and plumbing fixtures.
  2. Color(s): As selected by Architect from manufacturer's full line.
  3. Products:
    - a. ARDEX Engineered Cements; ARDEX SX: [www.ardexamericas.com/#sle](http://www.ardexamericas.com/#sle).
    - b. Custom Building Products; Commercial 100% Silicone Caulk: [www.custombuildingproducts.com/#sle](http://www.custombuildingproducts.com/#sle).
    - c. LATICRETE International, Inc; LATICRETE LATASIL: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
    - d. Merkrete, by Parex USA, Inc; 100% Silicone: [www.merkrete.com/sle](http://www.merkrete.com/sle).

## 2.06 ACCESSORY MATERIALS

- A. Cleavage Membrane Under Thick Mortar Bed:
1. Material: 4 mil thick polyethylene film.
- B. Reinforcing Mesh: 2 by 2 inch size weave of 16/16 wire size; welded fabric, galvanized.
- C. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 1/2 inch thick; 2 inch wide coated glass fiber tape for joints and corners.

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- D. Tile Cleaner: Neutral cleaner capable of removing soil and residue without harming tile and grout surfaces; specifically approved for materials and installations indicated by tile and grout manufacturers.
  - 1. Products:
    - a. Custom Building Products; Aqua Mix Heavy-Duty Tile and Grout Cleaner: [www.custombuildingproducts.com](http://www.custombuildingproducts.com)

## **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 tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

### **3.02 PREPARATION**

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

### **3.03 INSTALLATION - GENERAL**

- A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install ceramic accessories rigidly in prepared openings.
- G. Install thresholds where indicated.
- H. Sound tile after setting. Replace hollow sounding units.
- I. Keep control and expansion joints free of mortar, grout, and adhesive.
- J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- K. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

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### **3.04 INSTALLATION - FLOORS - THIN-SET METHODS**

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
  - 1. Use uncoupling membrane under all tile unless other underlayment is indicated.
  - 2. Where epoxy or furan grout is indicated, but not epoxy or furan bond coat, install in accordance with TCNA (HB) Method F115.
- B. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

### **3.05 INSTALLATION - FLOORS - MORTAR BED METHODS**

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F111, with cleavage membrane, unless otherwise indicated.
  - 1. Where epoxy or furan grout is indicated, but not epoxy or furan bond coat, install in accordance with TCNA (HB) Method F114, with cleavage membrane.
- B. Cleavage Membrane: Lap edges and ends.
- C. Mortar Bed Thickness: 5/8 inch, unless otherwise indicated.

### **3.06 INSTALLATION - SHOWERS AND BATHTUB WALLS**

- A. At tiled shower receptors install in accordance with TCNA (HB) Method B415, mortar bed floor, and W244, thin-set over cementitious backer unit walls.
- B. Grout with standard grout as specified above.

### **3.07 INSTALLATION - WALL TILE**

- A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.
- B. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.

### **3.08 CLEANING**

- A. Clean tile and grout surfaces.
- B. Seal tile surfaces.

### **3.09 PROTECTION**

- A. Do not permit traffic over finished floor surface for 4 days after installation.

**END OF SECTION**

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**SECTION 095100  
ACOUSTICAL CEILINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

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

**1.02 REFERENCE STANDARDS**

- A. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels 2019.
- B. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions 2022.
- C. ASTM E1264 - Standard Classification for Acoustical Ceiling Products 2022.
- D. ASCE 7 - Minimum Design Loads for buildings and Other Structures; 2010.
- E. CBC Section 1705 - California Building Code Section 1705A; Statement of Special Inspections.

**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 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components.

**1.05 QUALITY ASSURANCE**

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

**1.06 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; [\_\_\_\_]: [www.armstrong.com/#sle](http://www.armstrong.com/#sle).
  - 2. USG: [www.usg.com/#sle](http://www.usg.com/#sle).
- B. Suspension Systems:
  - 1. Same as for acoustical units.
  - 2. Armstrong World Industries, Inc: [www.armstrong.com/#sle](http://www.armstrong.com/#sle).
  - 3. USG: [www.usg.com/#sle](http://www.usg.com/#sle).

**2.02 ACOUSTICAL UNITS**

- A. Acoustical Units - General: ASTM E1264, Class A.
- B. Acoustical Panels: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:

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1. Size: 24 by 24 inches.
2. Thickness: 3/4 inches.
3. Composition: Wet felted.
4. Edge: Square.
5. Surface Color: White.

### **2.03 SUSPENSION SYSTEM(S)**

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars as required.
- B. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
  1. Finish: White painted.

### **2.04 ACCESSORIES**

- 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.
- D. Touch-up Paint: Type and color to match acoustical and grid units.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

### **3.02 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. Locate system on room axis according to reflected plan.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.
- F. 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.
- G. 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.
- H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- J. Do not eccentrically load system or induce rotation of runners.
- K. 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.



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

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install 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. Cut to fit irregular grid and perimeter edge trim.
  - 2. Make field cut edges of same profile as factory edges.
  - 3. Double cut and field paint exposed reveal edges.
- G. Where round obstructions occur, provide preformed closures to match perimeter molding.

### **3.04 FIELD QUALITY CONTROL**

- A. Regulatory Requirements: Special tests and inspections for suspended ceiling systems and anchorages per CBC Section 1705.3.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Remove and replace acoustical panel ceiling hangers and anchors and fasteners that do not pass tests and inspections and retest as specified above.
- D. 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**

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**SECTION 095423  
LINEAR METAL CEILINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Linear metal ceilings.
- B. Suspended metal support system and perimeter trim.

**1.02 REFERENCE STANDARDS**

- A. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels 2019.
- B. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions 2022.

**1.03 DESIGN REQUIREMENTS**

- A. Design components to ensure light fixtures will not induce eccentric loads. Where components may induce rotation of ceiling system components, provide stabilizing reinforcement.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate work of this section with installation of mechanical and electrical components and with other construction activities affected by work of this section.
- B. Sequencing: Supply hanger clips during steel deck erection. Supply additional hangers and inserts as required.

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate reflected ceiling plan.

**1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Accept factory-finished products on site in manufacturer's unopened factory packaging only; reject opened packages.
- B. Protect factory-finished products from damage to appearance by storing products in manufacturer's unopened factory packaging in dry storage area.

**1.08 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty; include coverage for corrosion resistance and discoloration of surface finish.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Linear Metal Ceilings:
  - 1. Armstrong; Metalworks.
  - 2. Substitutions: See Section 016000 - Product Requirements.

**2.02 LINEAR METAL CEILINGS**

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- A. Linear Metal Ceiling System: Panels and baffles, suspension members, trim, and accessories as required to provide a complete system.
- B. Performance Requirements:
  - 1. Design to support imposed loads of indicated items without eccentric loading of supports.
  - 2. Design for maximum deflection of 1/360 of span.

### 2.03 COMPONENTS

- A. Linear Metal Panels:
  - 1. Type: Linear panel with reveals; snap-in installation.
    - a. Size and Configuration: As indicated on drawings.
    - b. Panel Profile: Channel shaped with square edges.
    - c. Spacing: [ ] inch reveal between panels.
- B. Edge Molding, Expansion Joints, and Splices: Same material, thickness, and finish as linear panels.
- C. End Caps: Formed metal; same color and finish as sight-exposed surfaces of linear panels.
- D. Accessories: Stabilizer bars as required for suspended grid system; sight-exposed surfaces same color and finish as sight-exposed surfaces of linear panels.
- E. Suspension Members: Formed steel sections, with integral attachment points; galvanized finish; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- F. Suspension Wire: Steel, annealed, galvanized finish, 9 gage, 0.1144 inch diameter.
- G. Suspension Wire: Size and type as required for application, seismic requirements, and ceiling system flatness requirement specified.
- H. Subgirt Members: Prime painted steel sheet, formed to resist imposed loads and to provide attachment for linear ceiling and accessories.
- I. Touch-up Paint For Concealed Items: Zinc rich type.

### 2.04 FABRICATION

- A. Shop cut linear panels to accommodate mechanical and electrical items.
- B. Factory-form internal and external corners of same material, thickness, finish, and profile to match exposed linear panels ; back brace internal corners.

## 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.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Verify that field measurements are as indicated.

### 3.02 INSTALLATION

- A. Suspension Components:
  - 1. Install after above-ceiling work is complete in accordance with ASTM C636/C636M, ASTM E580/E580M, ASTM C636/C636M, ASTM E580/E580M, ASTM C636/C636M, and ASTM E580/E580M.
  - 2. Hang carrying members independent of walls, columns, ducts, light fixtures, pipe, and conduit; where carrying members are spliced, avoid visible displacement of face panels with adjacent panels.
  - 3. Where ducts or other equipment prevent regular spacing of hangers, reinforce nearest adjacent hangers to span the required distance.
  - 4. Locate suspension system for linear panel layout on room axis according to reflected plan.

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B. Linear Metal Ceiling:

1. Install linear panels and other system components in accordance with manufacturer's instructions.

**3.03 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.
- C. Maximum Variation From Dimensioned Position: 1/4 inch.

**3.04 CLEANING**

- A. Clean polished surfaces.
- B. Replace damaged or abraded components.

**END OF SECTION**

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**SECTION 096500  
RESILIENT FLOORING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Resilient tile flooring.
- B. Resilient base.
- C. Installation accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 260526 - Grounding and Bonding for Electrical Systems: Grounding and bonding of static control flooring to building grounding system.

**1.03 REFERENCE STANDARDS**

- A. ASTM D6329 - Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers 1998 (Reapproved 2015).
- B. ASTM F1344 - Standard Specification for Rubber Floor Tile 2021a.
- C. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing 2019.
- D. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings 2011.
- E. UL 2824 - GREENGUARD Certification Program Method for Measuring Microbial Resistance From Various Sources Using Static Environmental Chambers Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 013000 - 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.
- C. Shop Drawings: Indicate seaming plans and floor patterns.
- D. Verification Samples: Submit two samples, [ ] by [ ] inch in size illustrating color and pattern for each resilient flooring product specified.
- E. Concrete Sub-floor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
- G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience and approved by flooring manufacturer.

**1.06 QUALITY ASSURANCE**

- A. Resilient flooring shall be stable, firm, and slip resistant. CBC Section 11B-302.1.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

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- D. Do not double stack pallets.

### 1.08 FIELD CONDITIONS

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

## PART 2 PRODUCTS

### 2.01 SHEET FLOORING

- A. Vinyl Sheet Flooring: Homogeneous without backing, with color and pattern throughout full thickness.
  - 1. Manufacturers:
    - a. Gerflor.
  - 2. Minimum Requirements: Comply with ASTM F1913.
  - 3. Thickness: 0.080 inch nominal.
  - 4. Color: As indicated on drawings.

### 2.02 TILE FLOORING

- A. Vinyl Tile: Solid vinyl with color and pattern throughout thickness.
  - 1. Manufacturers:
    - a. Mohawk.
  - 2. Mold and Microbial Resistance: Highly resistant when tested in accordance with ASTM D6329; certified in accordance with UL 2824.
  - 3. Color: As indicated on drawings.
- B. Rubber Tile: Homogeneous, color and pattern throughout thickness.
  - 1. Manufacturers:
    - a. Mondo.
  - 2. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
  - 3. Total Thickness: 0.125 inch.
  - 4. Color: As indicated on drawings.

### 2.03 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style A, Straight.
  - 1. Manufacturers:
    - a. Johnsonite, a Tarkett Company: [www.johnsonite.com/#sle](http://www.johnsonite.com/#sle).
  - 2. Height: 4 inch.
  - 3. Finish: Satin.
  - 4. Length: Roll.
  - 5. Color: As indicated on drawings.
  - 6. Accessories: Premolded external corners and internal corners.

### 2.04 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Adhesive for Vinyl Flooring:
  - 1. Manufacturers:
    - a. Stauf USA, LLC; D737 High-Tack: [www.staufusa.com/#sle](http://www.staufusa.com/#sle).
    - b. TEC, an H.B. Fuller Construction Products Brand; TEC Roll Fast Vinyl Flooring Adhesive: [www.tecspecialty.com/#sle](http://www.tecspecialty.com/#sle).
- D. Spread only enough adhesive to permit installation of materials before initial set.

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- E. Fit joints and butt seams tightly.
- F. Set flooring in place, press with heavy roller to attain full adhesion.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- I. Install flooring in recessed floor access covers, maintaining floor pattern.

### **PART 3 EXECUTION**

- A. Install feature strips where indicated.

#### **3.02 EXAMINATION**

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. 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 resilient base.
- C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
  - 1. Test in accordance with Section 090561.
- D. Verify that required floor-mounted utilities are in correct location.

#### **3.03 PREPARATION**

- A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI (RWP).
- B. Prepare floor substrates for installation of flooring in accordance with Section 090561.
- C. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

#### **3.04 INSTALLATION - GENERAL**

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Adhesive-Applied Installation:
  - 1. Spread only enough adhesive to permit installation of materials before initial set.
  - 2. Place copper grounding strip in conductive adhesive and apply additional adhesive to top side of strip before installing static control flooring. Allow strip to extend beyond flooring in accordance with static control flooring manufacturer's instructions. Refer to Section 260526 for grounding and bonding to building grounding system.
  - 3. Fit joints and butt seams tightly.
  - 4. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

#### **3.05 INSTALLATION - SHEET FLOORING**

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Cut sheet at seams in accordance with manufacturer's instructions.

#### **3.06 INSTALLATION - TILE FLOORING**

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

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**3.07 INSTALLATION - RESILIENT BASE**

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

**3.08 CLEANING**

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

**3.09 PROTECTION**

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

**END OF SECTION**



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**SECTION 096813  
TILE CARPETING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Carpet tile, fully adhered.
- B. Removal of existing carpet tile.

**1.02 REFERENCE STANDARDS**

- A. CBC Section 1124B; Ground and Floor Surfaces.
- B. CRI (GLA) - Green Label Testing Program - Approved Adhesive Products; Carpet and Rug Institute; Current Edition.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- D. Concrete Sub-floor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - Product Requirements, for additional provisions.
  - 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.
- C. Carpet / Carpet Tile Flooring: CBC Section 11B-302.2
  - 1. Carpet shall be securely attached and shall have a firm cushion, pad, or backing or no cushion or pad. It shall have a level loop, textured loop, level cut pile, or level cut/uncut pile texture. Pile height shall be 1/2 inch maximum.
  - 2. Exposed edges shall be fastened to floor surfaces and shall have trim on the entire length. Carpet edges shall comply with CBC Section 11B-303.

**1.05 FIELD CONDITIONS**

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Tile Carpeting:
  - 1. Mohawk.

**2.02 MATERIALS**

- A. Tile Carpeting: Tufted, manufactured in one color dye lot.
  - 1. Color: As indicated on plans.
  - 2. Pattern: As indicated on plans.

**2.03 ACCESSORIES**

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- A. Adhesives:
- B. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.
- C. Adhesives: Acceptable to carpet tile manufacturer, compatible with materials being adhered; maximum VOC of 50 g/L; CRI Green Label certified; in lieu of labeled product, independent test report showing compliance is acceptable.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
- C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.
  - 1. Test in accordance with Section 090561.
  - 2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

#### **3.02 PREPARATION**

- A. Remove existing carpet tile.
- B. Prepare floor substrates for installation of flooring in accordance with Section 090561.
- C. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.

#### **3.03 INSTALLATION**

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
- F. Fully adhere carpet tile to substrate.
- G. Trim carpet tile neatly at walls and around interruptions.
- H. Complete installation of edge strips, concealing exposed edges.

#### **3.04 CLEANING**

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

**END OF SECTION**

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**SECTION 097800  
INTERIOR WALL PANELING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Glass interior wall paneling.
- B. Accessories.

**1.02 REFERENCE STANDARDS**

- A. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015 (Reaffirmed 2020).
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's descriptive literature for each specified product. Include anchorage devices specific to project substrate types.
- C. Shop Drawings: Submit elevations for each application and location. Indicate details of joints and attachments.
  - 1. Scale of Drawing Elevations: 1/4 inch to 1 foot, minimum.
- D. Samples: Submit two samples 12 by 12 inches in size, indicating finish, surface design, and color for each type of panels.
- E. Warranty Documentation: Manufacturer warranty; ensure that forms have been completed in Owner's name and registered with manufacturer.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least five years of documented experience.
- B. Installer Qualifications: Company specializing in installing work of the type specified in this section, and with at least three years of documented experience.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to project site in manufacturer's original packaging, marked with manufacturer's product identification.
- B. 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.
- C. Packaging Waste Management: See Section 017419.

**1.06 WARRANTY**

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Extended Correction Period: Correct defective work within a five-year period for [ ] commencing on the Date of Substantial Completion.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Glass Interior Wall Paneling:
  - 1. Bendheim Wall Systems, Inc: [www.bendheim.com/#sle](http://www.bendheim.com/#sle).
  - 2. Forms and Surfaces, Inc: [www.forms-surfaces.com/#sle](http://www.forms-surfaces.com/#sle).
  - 3. Goldray Industries, Inc; Mosaic: [www.goldrayglass.com/#sle](http://www.goldrayglass.com/#sle).

**2.02 REGULATORY REQUIREMENTS**

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- A. Surface Burning Classification: Provide wall paneling assemblies meeting Class A when tested in accordance with ASTM E84.

### **2.03 GLASS INTERIOR WALL PANELING**

- A. Fully-Framed Modular Glass Cladding System:
  - 1. Applications: Wall cladding.
  - 2. Panel Size: As indicated on drawings.
  - 3. Glass Type: Float glass.
  - 4. Thickness: As required for application.
  - 5. Shaping and Edge Finishing: Edge grinding prior to heat-treatment.
  - 6. Colors: As indicated on drawings.
  - 7. Finish: Glossy surface.
  - 8. Glazing Method: Manufacturer's standard glazing method.
  - 9. Frame Type: Hidden profile.
  - 10. Frame Finish: Color from manufacturer's standard range.
- B. Materials:
  - 1. Float Glass: Provide float glass-based glazing unless otherwise indicated.
    - a. Fully Tempered Safety Glass: Comply with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
- C. Fabrication:
  - 1. Shop fabricate to greatest extent possible.
  - 2. Factory-assemble individual framing components, miter corners, and rivet corner attachments.
- D. Accessories:
  - 1. Fasteners: Manufacturers standard wall clips, glazing tape, and anchorage devices.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that substrate surfaces for adhered items are clean and smooth.
  - 1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer.
  - 2. Comply with adhesive manufacturer's recommendations for remedial measures at locations and application conditions where adhesion test results are unsatisfactory.
- C. Start of installation constitutes acceptance of project conditions.

#### **3.02 INSTALLATION**

- A. Install panels in accordance with manufacturer's instructions.
- B. Apply adhesive to back side of panel using trowel recommended by adhesive manufacturer.
- C. Apply panels to wall with vertical joints plumb and horizontal joints level and pattern aligned with adjoining panels.
- D. Using a roller, apply pressure to panel face to ensure proper adhesion between surfaces.
- E. Install panels with manufacturer's recommended gaps for panel field and corner joints.
- F. Install trim with adhesive.
- G. Seal joints at wall base and between panels with approved sealant to prevent moisture intrusion.
- H. Remove excess sealant after paneling is installed and prior to curing.

#### **3.03 ADJUSTING**

- A. Replace paneling installed out of plumb and/or not aligned with adjacent panels or construction.

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### **3.04 CLEANING**

- A. See Section 017000 - Execution and Closeout Requirements for additional requirements.
- B. Remove nonpermanent labels immediately after glazing installation is complete.
- C. Clean glass and framing on exposed surfaces not more than four days prior to Date of Substantial Completion in accordance with manufacturer's written recommendations.
- D. Clean panel faces using cleaning agents and methods recommended by manufacturer to remove soiling.

### **3.05 CLOSEOUT ACTIVITIES**

- A. See Section 017800 - Closeout Submittals for closeout submittals.

### **3.06 PROTECTION**

- A. Protect installed interior wall paneling from subsequent construction operations.

**END OF SECTION**

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**SECTION 099113  
EXTERIOR PAINTING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
- D. Do Not Paint or Finish the Following Items:
  - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
  - 2. Items indicated to receive other finishes.
  - 3. Items indicated to remain unfinished.
  - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
  - 5. Non-metallic roofing and flashing.
  - 6. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, zinc, and lead.
  - 7. Marble, granite, slate, and other natural stones.
  - 8. Floors, unless specifically indicated.
  - 9. Ceramic and other types of tiles.
  - 10. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster and stucco.
  - 11. Glass.
  - 12. Concealed pipes, ducts, and conduits.

**1.02 RELATED REQUIREMENTS**

- A. Section 099123 - Interior Painting.
- B. Section 099600 - High-Performance Coatings.

**1.03 REFERENCE STANDARDS**

- A. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials 2020.
- B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.
- C. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).
- D. SSPC-SP 2 - Hand Tool Cleaning 2018.
- E. SSPC-SP 6 - Commercial Blast Cleaning 2007.
- F. SSPC-SP 13 - Surface Preparation of Concrete 2018.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of 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. MPI product number (e.g. MPI #47).
  - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
  - 4. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.

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- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
  - 1. Where sheen is specified, submit samples in only that sheen.
  - 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.
- D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience and approved by manufacturer.

### 1.06 MOCK-UP

- A. See Section 014000 - Quality Requirements, for general requirements for mock-up.
- B. Provide panel, 10 feet long by 10 feet wide, illustrating paint color, texture, and finish.
- C. Provide door and frame assembly illustrating paint color, texture, and finish.
- D. Mock-up may remain as part of the work.

### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

### 1.08 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Provide paints and finishes from the same manufacturer.
  - 1. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
- B. Paints:
  - 1. Base Manufacturer: Sherwin-Williams.
  - 2. PPG Paints: [www.ppgpaints.com/#sle](http://www.ppgpaints.com/#sle).
  - 3. Sherwin-Williams Company: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).

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4. Dunn-Edwards Corporation: www.dunnedwards.com.

C. Primer Sealers: Same manufacturer as top coats.

## 2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
  3. Supply each paint material in quantity required to complete entire project's work from a single production run.
  4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Flammability: Comply with applicable code for surface burning characteristics.
- C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- D. Colors: As indicated in Color Schedule.
1. Extend colors to surface edges; colors may change at any edge as directed by Architect.

## 2.03 PAINT SYSTEMS - EXTERIOR

- A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including concrete and plaster.
1. Two top coats and one coat primer.
  2. Top Coat(s): Exterior Latex.
    - a. Products:
      - 1) Sherwin-Williams Pro Industrial Acrylic.
  3. Top Coat Sheen:
    - a. Eggshell: MPI gloss level 3; use this sheen at all locations.
  4. Primer: As specified under "PRIMERS" below.
- B. Paint ME-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:
1. One coat of alkyd primer.
  2. Semi-gloss: Two coats of alkyd enamel.
- C. Paint ME-OP-3L - Ferrous Metals, Unprimed, Latex, 3 Coat:
1. One coat of latex primer.
  2. Semi-gloss: Two coats of latex enamel.
- D. Paint ME-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:
1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
  2. Semi-gloss: Two coats of alkyd enamel.
- E. Paint ME-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
  2. Semi-gloss: Two coats of latex enamel.
- F. Paint MgE-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
1. One coat galvanize primer.
  2. Semi-gloss: Two coats of alkyd enamel.
- G. Paint MgE-OP-3L - Galvanized Metals, Latex, 3 Coat:
1. One coat galvanize primer.
  2. Semi-gloss: Two coats of latex enamel.
- H. Paint E-Pav - Pavement Marking Paint:
1. White: One coat, with reflective particles.



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## 2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
  - 1. Alkali Resistant Water Based Primer.
    - a. Products:
      - 1) Sherwin-Williams Loxon Concrete and Masonry Primer.
  - 2. Anti-Corrosive Alkyd Primer for Metal; MPI #79.
  - 3. Interior/Exterior Quick Dry Alkyd Primer for Metal; MPI #76.
  - 4. Water Based Primer for Galvanized Metal; MPI #134.
  - 5. Rust-Inhibitive Water Based Primer; MPI #107.

## 2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
  - 1. Exterior Plaster and Stucco: 12 percent.
  - 2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
  - 3. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

### 3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Concrete:
  - 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
  - 2. Clean surfaces with pressurized water. Use pressure range of 1,500 to 4,000 psi at 6 to 12 inches. Allow to dry.
  - 3. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
- G. Exterior Plaster: Fill hairline cracks, small holes, and imperfections with exterior patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- H. Galvanized Surfaces:

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1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
  2. Prepare surface according to SSPC-SP 2.
- I. Ferrous Metal:
    1. Solvent clean according to SSPC-SP 1.
    2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
  - J. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied. Back prime concealed surfaces before installation.
  - K. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

### 3.03 APPLICATION

- A. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.
- B. Apply products in accordance with manufacturer's written instructions.
- C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance.
- F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.
- G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

### 3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for general requirements for field inspection.
- B. Owner will provide field inspection.

### 3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

### 3.06 PROTECTION

- A. Touch-up damaged finishes after Substantial Completion.

**END OF SECTION**

**SECTION 099123  
INTERIOR PAINTING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
  - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
  - 2. Elevator pit ladders.
  - 3. Surfaces inside cabinets.
  - 4. Prime surfaces to receive wall coverings.
  - 5. Mechanical and Electrical:
    - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
    - b. In finished areas, paint shop-primed items.
    - c. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
    - d. Paint dampers exposed behind louvers, grilles, to match face panels.
- D. Do Not Paint or Finish the Following Items:
  - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
  - 2. Items indicated to receive other finishes.
  - 3. Items indicated to remain unfinished.
  - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
  - 5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
  - 6. Marble, granite, slate, and other natural stones.
  - 7. Floors, unless specifically indicated.
  - 8. Ceramic and other tiles.
  - 9. Glass.
  - 10. Acoustical materials, unless specifically indicated.
  - 11. Concealed pipes, ducts, and conduits.

**1.02 REFERENCE STANDARDS**

- A. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of 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. MPI product number (e.g. MPI #47).
  - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
  - 4. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.

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1. Where sheen is specified, submit samples in only that sheen.
  2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.
  3. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as factory finished metals, have been approved.
- D. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected. Submit on paper, 8 by 11 inch in size.
- E. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

#### **1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience and approved by manufacturer.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

#### **1.06 FIELD CONDITIONS**

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply materials when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.
- D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Provide paints and finishes from the same manufacturer.
  1. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
- B. Paints:
  1. Base Manufacturer: Sherwin-Williams.
  2. PPG Paints: [www.ppgpaints.com/#sle](http://www.ppgpaints.com/#sle).
  3. Sherwin-Williams Company: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
  4. Dunn-Edwards Corporation: [www.dunnedwards.com](http://www.dunnedwards.com).
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Section 016000 - Product Requirements.

#### **2.02 PAINTS AND FINISHES - GENERAL**

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- A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
  - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  - 2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
  - 3. Supply each paint material in quantity required to complete entire project's work from a single production run.
  - 4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content: Comply with Section 016116.
- C. Flammability: Comply with applicable code for surface burning characteristics.
- D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- E. Colors: As indicated on drawings.
  - 1. Extend colors to surface edges; colors may change at any edge as directed by Architect.
  - 2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

### 2.03 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, wood, uncoated steel, and shop primed steel.
  - 1. Two top coats and one coat primer.
  - 2. Top Coat(s): Interior Latex.
    - a. Products:
      - 1) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Flat.
      - 2) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Semi-Gloss. (MPI #43)
      - 3) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Eg-Shel. (MPI #52)
  - 3. Top Coat Sheen:
    - a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
    - b. Eggshell: MPI gloss level 3; use this sheen at all locations.
    - c. Semi-Gloss: MPI gloss level 5; use this sheen where indicated.
  - 4. Primer: Sherwin-Williams ProMar 200 Zero VOC Latex Primer.
- B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals:
  - 1. Medium duty applications include doors, door frames, guardrails, and metal columns.
  - 2. Two top coats and one coat primer.
  - 3. Top Coat(s): High Performance Architectural Interior Latex; MPI #139, 140, or 141.
    - a. Products:
      - 1) Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, Semi-Gloss. (MPI #141)
  - 4. Top Coat Sheen:
    - a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
  - 5. Primer: Sherwin-Williams Pro Industrial Pro-Cryl Universal Acrylic Primer.
- C. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in high-bay spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, and galvanized piping.
  - 1. Shop primer by others.
  - 2. One top coat.
  - 3. Top Coat: Latex Dry Fall.
    - a. Products:

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- 1) Sherwin-Williams Waterborne Acrylic Dryfall, Flat. (MPI #118)
4. Top Coat Sheen:
  - a. Flat: MPI gloss level 1; use this sheen at all locations.
5. Primer: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer.

#### **2.04 ACCESSORY MATERIALS**

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Do not begin application of paints and finishes until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
  1. Gypsum Wallboard: 12 percent.

#### **3.02 PREPARATION**

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- F. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- G. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
  1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
  2. Prepare surface according to SSPC-SP 2.
  3. 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. Re-prime entire shop-primed item.
- H. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

#### **3.03 APPLICATION**

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

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- E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- G. Sand wood and metal surfaces lightly between coats to achieve required finish.
- H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

**3.04 FIELD QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements, for general requirements for field inspection.
- B. Owner will provide field inspection.

**3.05 CLEANING**

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

**3.06 PROTECTION**

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

**END OF SECTION**

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**SECTION 099620  
PERMANENT NON-SACRIFICIAL ANTI-GRAFFITI COATING**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Anti-graffiti coating systems vertical surfaces for brick masonry, cast-in-place building concrete, cast-in-place site concrete, and architectural site concrete..
- B. Surface preparation
- C. field application

**1.02 RELATED SECTIONS INCLUDE THE FOLLOWING:**

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 099000 - Painting and Coating.
- C. Section 033000 - Cast-in-Place Concrete; Bulidng concrete
- D. Section 042000 - Unit Masonry; Concrete unit masonry construction.
- E. Section 079005 - Joint Sealers; Joint sealants.
- F. Section 323300 - Architectural Site Concrete

**1.03 REGULATORY REQUIREMENTS**

- A. California Air Resources Board, Volatile Organic Compound (VOC) Limitation: Provide anti-graffiti coating materials, including primers, undercoats, and finish-coat materials, that have a VOC content of 100 g/l or less, consistent with Southern California Air Quality Management District (SCAQMD) Rule 1113 for architectural flat coatings.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating coating materials and installation recommendations.
- C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Maintenance Data: Include cleaning procedures and repair and patching techniques.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Coating Materials: 1 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.

**1.05 QUALITY ASSURANCE**

- A. Maintain one copy of each referenced document that applies to application on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

**1.06 MOCK-UP**

- A. Apply Sealer and Anti-graffiti coating to approved Architectural Site Concrete Mock-ups for review and approval by Architect and client prior to beginning work.
- B. Locate where directed.
- C. Mock-up may not remain as part of the Work.

**1.07 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.



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- B. Correct defective Work within one year period after Date of Substantial Completion.
- C. Warranty: Include coverage for bond to substrate.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Basis-of-Design Products: The design for each non-sacrificial anti-graffiti coating system is based on the products indicated.
- B. Type 2, Silane/Siloxane-Based Systems:
  - 1. Rainguard International Inc., VandlGuardTEN non-sacrificial Anti-Graffiti System.
    - a. Sealer; Product Micro-Seal Water Repellant.
    - b. Non-Sacrificial Coating; Product VandlGuardTEN
    - c. Finish Coat; Product VandlGuard Finish Coat.

### **2.02 PERFORMANCE REQUIREMENTS**

- A. General: Non-sacrificial anti-graffiti coating system with the following properties:
  - 1. Superior protection against, and easy removal of, unwanted graffiti.
  - 2. Minimum alteration of appearance of treated surface when compared to untreated surface, including gloss and color.
  - 3. Minimum alteration of water vapor transmission rate through complete wall system.
    - a. Coating system shall have a minimum water vapor transmission rate of 95 percent when tested per ASTM D1653.
- B. Completed coating system performance shall comply with ASTM D 6578 "Standard Practice for Determination of Graffiti Resistance," and the following:
  - 1. Cleanability Level 3: Achieve Level 3 cleaning performance, removing all test graffiti items using citrus-based cleaners or milder solvents.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrates and conditions under which anti-graffiti coatings will be applied, for compliance with coating application requirements.
- B. Apply coatings only after unsatisfactory conditions have been corrected and surfaces to receive coatings are thoroughly dry.

### **3.02 PREPARATION**

- A. General: Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item; provide surface-applied protection before surface preparation and coating.
  - 1. After completing coating operations, reinstall items that were removed, using workers skilled in the trades involved.
- B. Surface Preparation: Clean and prepare surfaces to be coated according to manufacturer's written instructions for each substrate condition and as specified.
  - 1. Prepare concrete and brick to be coated. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods to prepare surfaces.
  - 2. Surfaces to receive sealer shall be cleaned of dirt, oil, graffiti, grease, laitance, and other contaminants.
  - 3. Mid-pressure water (1500 psi) washing is the minimum cleaning that will be accepted, other methods, such as abrasive blasting and power may be submitted for review.
  - 4. Schedule cleaning and coating application so dust and other contaminates from cleaning process will not fall on wet, newly coated surfaces.
- C. Material Preparation: Carefully mix and prepare coating materials according to manufacturer's written instructions.

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1. Maintain containers used in mixing and applying coatings in a clean condition, free of foreign materials and residue.
  2. Stir materials before applying to produce a mixture of uniform density. Stir as required during application.
  3. Do not stir surface film into the material. Remove film and, if necessary, strain coating material before using.
  4. Use only the type of thinners approved by manufacturer and only within recommended limits.
- D. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of coating system components. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of components being deposited on surfaces. Cover live plants and grass.
- E. Coordination with Sealants: Do not apply anti-graffiti coatings until sealants for joints adjacent to surfaces receiving coatings have been installed and cured.
1. Anti-graffiti coating work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, anti-graffiti coatings, and sealant materials identical to those used in the work.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.03 APPLICATION

- A. General: Apply anti-graffiti coatings according to manufacturer's written instructions.
1. Use applicators and techniques best suited for the material being applied.
  2. Do not apply anti-graffiti coatings over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to forming a durable coating film.
  3. Coating surface treatments and finishes are indicated in the coating system descriptions.
  4. Provide finish coats compatible with primers used.
  5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, drinking fountains, grilles, covers for electrical equipment, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
- B. Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces.
1. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
- C. Scheduling Coating: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for coating as soon as practicable after preparation and before subsequent surface deterioration.
- D. The number of coats and film thickness required is the same regardless of application method.
1. Micro-Seal- one (1) coat
  2. VandlGuard TEN- two (2) coats
  3. VandlGuard Finish Coat- one (1) coat
- E. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. Allow sufficient time between successive coats to permit proper drying.
- F. Give special attention to edges, corners, crevices, and similar surfaces to ensure that they receive a dry film thickness equivalent to that of flat surfaces.
- G. Application Procedures: Apply coatings according to manufacturer's written instructions.
1. Spray Equipment: Use spray equipment with pressure and orifice size recommended by manufacturer for material and texture required.
- H. Minimum Coating Thickness: Apply each material no thinner than manufacturers recommended spreading rate.
1. Provide total dry film thickness of the entire system as recommended by manufacturer.
- I. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by manufacturer, to material required to be coated or finished that has not been prime coated by

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others.

- J. Recoat primed and sealed substrates immediately if there is evidence of suction spots or unsealed areas in first coat, to ensure a finish coat with no burn-through or other defects caused by insufficient sealing.
- K. Completed Work: Match accepted mockups for shade and coverage. Remove, refinish, or recoat work that does not comply with specified requirements.

**3.04 FIELD QUALITY CONTROL**

- A. Provide the services of the manufacturer's authorized field representative to verify that installed products comply with manufacturer's requirements and with the standard established by the Architect approved mockup/test panels.
- B. Remove and replace work where test results indicate that it does not comply with specified requirements.

**3.05 CLEANING**

- A. Immediately clean anti-graffiti coatings from adjoining surfaces and surfaces soiled or damaged by application as work progresses. Repair damage caused by application. Comply with manufacturer's written cleaning instructions.
- B. Clean up debris and unused material and remove from site.

**3.06 PROTECTION**

- A. Protect work of other trades, whether being coated or not, against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

**END OF SECTION**

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**SECTION 101100  
VISUAL DISPLAY UNITS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Markerboards and Tackboards.

**1.02 REFERENCE STANDARDS**

- A. ANSI A208.1 - American National Standard for Particleboard 2022.
- B. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling 2018.
- C. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board 2022.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on chalkboard, markerboard, tackboard, tackboard surface covering, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations , special anchor details.
- D. Samples: Submit two samples 2 by 2 inch in size illustrating materials and finish, color and texture of chalkboard, markerboard, tackboard, tackboard surfacing, and trim.

**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 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Visual Display Boards:
  1. ADP Lemco, Inc: [www.adplemco.com/#sle](http://www.adplemco.com/#sle).
  2. Claridge Products and Equipment, Inc: [www.claridgeproducts.com/#sle](http://www.claridgeproducts.com/#sle).
  3. MooreCo, Inc: [www.moorecoinc.com/#sle](http://www.moorecoinc.com/#sle).
  4. Polyvision Corporation (Nelson Adams): [www.polyvision.com/#sle](http://www.polyvision.com/#sle).

**2.02 VISUAL DISPLAY BOARDS**

- A. Markerboards: Porcelain enamel on steel, laminated to core.
  1. Color: White.
  2. Steel Face Sheet Thickness: 24 gage, 0.0239 inch .
  3. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
  4. Backing: Aluminum foil, laminated to core.
  5. Size: As indicated on drawings.
  6. Frame: Extruded aluminum , with concealed fasteners.
  7. Frame Finish: Anodized, natural.
  8. Accessories: Provide chalk tray and map rail.
- B. Tackboards: Fabric laminated to fiberboard.
  1. Fabric: Vinyl coated fabric.
  2. Color: As indicated on drawings.
  3. Backing: Fiberboard, 3/8 inch thick, laminated to tack surface.

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4. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
  5. Size: As indicated on drawings.
  6. Frame: No frame , with concealed fasteners.
  7. Accessories: Provide map rail.
- C. Combination Units and Units Made of More Than One Panel: Factory-assembled markerboards and tackboards in a single frame, of materials specified above.
1. Join panels of similar construction with butt joints, aligned and secured with steel spline concealed in edge of core.
  2. Configuration: As indicated on drawings.

### 2.03 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Vinyl-Coated Fabric: Roll stock, as indicated on plans.
- C. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- D. Fiber Board: ASTM C208, cellulosic fiber board.
- E. Foil Backing: Aluminum foil sheet, 0.005 inch thick.
- F. Adhesives: Type used by manufacturer.

### 2.04 ACCESSORIES

- A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall , full width of frame.
- B. Map Supports: Formed aluminum sliding hooks and roller brackets to fit map rail.
- C. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.
- D. Flag Holders: Cast aluminum bored to receive 1 inch diameter flag staff, bracketed to fit top rail of board.
- E. Cleaning Instruction Plate: Provide instructions for chalkboard cleaning on a metal plate fastened to perimeter frame near chalkrail.
- F. Chalk Tray: Aluminum, manufacturer's standard profile, one piece full length of chalkboard, molded ends, concealed fasteners, same finish as frame.
- G. Mounting Brackets: Concealed.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.
- C. Verify flat wall surface for frameless adhesive-applied boards.

### 3.02 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Secure units level and plumb.
- C. Butt Joints: Install with tight hairline joints.

### 3.03 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Date of Substantial Completion.

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**END OF SECTION**

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## SECTION 101400 SIGNAGE

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Room and door signs.
- B. Interior directional and informational signs.

#### 1.02 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

#### 1.03 SUBMITTALS

- A. See Section 013000 - 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.
- E. Verification Samples: Submit samples showing colors specified.

#### 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

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CBC Section and Figure 11B-703.4.2 as follows:

- 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. Inspection- Tactile signs shall be field inspected for compliance after installation (11B-703.1.1.2)

C.

### 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.
- C. Store tape adhesive at normal room temperature.

### 1.06 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Flat Signs:
  1. Best Sign Systems, Inc: [www.bestsigns.com/#sle](http://www.bestsigns.com/#sle).
  2. Cosco Industries (ADA signs); ADA Series 1: [www.coscoarchitecturalsigns.com/#sle](http://www.coscoarchitecturalsigns.com/#sle).
  3. FASTSIGNS: [www.fastsigns.com/#sle](http://www.fastsigns.com/#sle).
  4. Inpro: [www.inprocorp.com/#sle](http://www.inprocorp.com/#sle).
  5. Mohawk Sign Systems, Inc: [www.mohawksign.com/#sle](http://www.mohawksign.com/#sle).
  6. Seton Identification Products: [www.seton.com/aec/#sle](http://www.seton.com/aec/#sle).
- B. Dimensional Letter Signs:
  1. A.R.K. Ramos Architectural Signage Systems; Cast Aluminum Letters: [www.arkramos.com/#sle](http://www.arkramos.com/#sle).
  2. Cosco Industries; Cast Aluminum: [www.coscoarchitecturalsigns.com/#sle](http://www.coscoarchitecturalsigns.com/#sle).
  3. FASTSIGNS: [www.fastsigns.com/#sle](http://www.fastsigns.com/#sle).
  4. Inpro: [www.inprocorp.com/#sle](http://www.inprocorp.com/#sle).

### 2.02 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
  1. Sign Type: Flat signs with engraved panel media as specified.
  2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
  3. Character Height: 1 inch.
  4. Sign Height: 2 inches, unless otherwise indicated.
  5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.



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6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
  7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
  8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Interior Directional and Informational Signs:
1. Sign Type: Same as room and door signs.
  2. Sizes: As indicated on drawings.
- D. Other Dimensional Letter Signs: Wall-mounted or free standing as indicated on plans.

### 2.03 SIGN TYPES

- A. Flat Signs: Signage media without frame.
1. Edges: Square.
  2. Corners: Square.
  3. Wall Mounting of One-Sided Signs: Tape adhesive.
- 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. Injection Molded Panels: One-piece acrylic plastic, with raised letters and braille.
1. Total Thickness: 1/8 inch.

### 2.05 NON-TACTILE SIGNAGE MEDIA

- A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface:
1. Sign Color: Color as selected.
  2. Total Thickness: 1/8 inch.

### 2.06 DIMENSIONAL LETTERS

- A. Metal Letters:
1. Metal: Aluminum casting.
  2. Metal Thickness: 1/8 inch minimum.
  3. Finish: Factory painted.
  4. Material: Aluminum.
  5. Color: As indicated.
  6. Mounting: pinned. or mounted to concrete base.

### 2.07 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Tape Adhesive: Double sided tape, permanent adhesive.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

### 3.02 INSTALLATION

- A. Install neatly, with horizontal edges level.

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- 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**

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**SECTION 102113.19  
PLASTIC TOILET COMPARTMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Solid plastic toilet compartments.
- B. Urinal and vestibule screens.

**1.02 REFERENCE STANDARDS**

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

**1.04 SUBMITTALS**

- A. See Section 013000 - 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, \_\_\_\_by\_\_\_\_ inch in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

**1.05 QUALITY ASSURANCE**

- A. Accessible Toilet Compartments: CBC Section 11B-604
  - 1. Wheelchair accessible compartment shall comply with CBC Section 11B-604.8.1.
  - 2. Toe clearance for at least one side partition of a wheelchair accessible compartment shall comply with CBC Section and Figure 11B-604.8.1.4. It shall be 9 inches high minimum above the finish floor and 6 inches deep minimum beyond the compartment side face of the partition, exclusive of partition support members. It shall be 12 inches high minimum above the finish floor for children's use. Partition components at toe clearances shall be smooth without sharp edges or abrasive surfaces. Toe clearances at the side partition is not required in a compartment greater than 66 inches wide.
  - 3. An ambulatory accessible compartment shall be provided where there are six or more toilet compartments, or where the combination of urinals and water closets totals six or more per CBC Section 11B-213.3.1. Such compartment shall comply with CBC Section 11B-604.8.2.
  - 4. Door and door hardware for accessible compartments shall be self-closing and shall comply with CBC Section 11B-404 except that pull-side clearance for ambulatory accessible compartments shall be a minimum of 44 inches clear, rather than 60 inches. CBC Figure 11B-604.8.2.
  - 5. A door pull complying with CBC Section 11B-404.2.7 shall be placed on both sides of the door near the latch.
  - 6. Doors shall not swing into clear floor space or clearance required for any fixtures.
  - 7. Install coat hook at 48 inches maximum above finished floor.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Solid Plastic Toilet Compartments:
  - 1. Scranton Products (Santana/Comtec/Capital): [www.scrantonproducts.com/#sle](http://www.scrantonproducts.com/#sle).

**2.02 PLASTIC TOILET COMPARTMENTS**

- A. Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286; floor-mounted unbraced.

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- B. Doors:
  1. Thickness: 1 inch.
  2. Width: 24 inch.
  3. Width for Handicapped Use: 36 inch, out-swinging.
  4. Height: 55 inch.
- C. Panels:
  1. Thickness: 1 inch.
  2. Height: 55 inch.
- D. Pilasters:
  1. Thickness: 1 inch.
  2. Width: As required to fit space; minimum 3 inch.
- E. Screens: Without doors; to match compartments; mounted to wall with two panel brackets.

### 2.03 ACCESSORIES

- A. Pilaster Shoes: Stainless steel, satin finish, 3 inches high; concealing floor fastenings.
  1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
- B. Head Rails: Extruded aluminum, anti-grip profile.
- C. Wall Brackets: Stainless steel; manufacturer's standard type for conditions indicated on drawings.
- D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
  1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.
- E. Hinges: Stainless steel, manufacturer's standard finish.
  1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
  2. Continuous-type hinge, self closing.
- F. Door Hardware: Stainless steel, manufacturer's standard finish.
  1. Door Latch: Slide type with exterior emergency access feature.
  2. Provide door pull for outswinging doors.
- G. Coat Hook with Rubber Bumper: One per compartment, mounted on door.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

### 3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch 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: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

### 3.04 ADJUSTING

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- 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**

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**SECTION 102800  
TOILET, BATH, AND LAUNDRY ACCESSORIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Utility room accessories.

**1.02 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service 2015a (Reapproved 2019).
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- D. ASTM B86 - Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings 2018, with Editorial Revision (2021).
- E. ASTM C1036 - Standard Specification for Flat Glass 2021.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror 2018.
- H. CBC 1118B - Space Allowance and Reach Ranges; California Building Code.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

**1.05 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. Bobrick Washroom Equipment, Inc.: [www.bobrick.com](http://www.bobrick.com).
- B. Under-Lavatory Pipe Supply Covers:
  - 1. Plumberex Specialty Products, Inc: [www.plumberex.com/#sle](http://www.plumberex.com/#sle).

**2.02 MATERIALS**

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- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
  - 1. Grind welded joints smooth.
  - 2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.
- B. Keys: Provide 2 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. Zinc Alloy: Die cast, ASTM B86.
- F. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- G. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.
- H. Adhesive: Two component epoxy type, waterproof.
- I. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

### 2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.

### 2.04 COMMERCIAL TOILET ACCESSORIES

- A. Toilet Paper Dispenser: Single roll, semi-recessed, stainless steel unit with pivot hinge, tumbler lock.
- B. Combination Towel Dispenser/Waste Receptacle: Recessed with projecting waste receptacle, stainless steel; seamless wall flanges, continuous piano hinges.
- C. Soap Dispenser: Liquid soap dispenser, wall-mounted, surface, with stainless steel cover and horizontal stainless steel tank and working parts; push type soap valve, check valve, and window gauge refill indicator, tumbler lock.
- D. Air Freshener Dispenser: Wall-mounted, battery operated.
  - 1. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
    - a. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
    - b. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
    - c. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
- E. Seat Cover Dispenser: Stainless steel, surface-mounted, reloading by concealed opening at base, tumbler lock.
- F. Grab Bars: Stainless steel, smooth surface.
  - 1. Standard Duty Grab Bars:
    - a. Push/Pull Point Load: 250 pound-force, minimum.
    - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
    - c. Finish: Satin.
    - d. Length and Configuration: As indicated on drawings.

### 2.05 COMMERCIAL SHOWER AND BATH ACCESSORIES

- A. Shower Curtain Rod: Stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for installation with exposed fasteners.
- B. Shower Curtain:

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1. Material: Opaque vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
  2. Grommets: Stainless steel; pierced through top hem on 6 inch centers.
  3. Color: White.
  4. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
- C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand seat.
1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of color as selected.
  2. Size: ADA Standards compliant.

## **2.06 UTILITY ROOM ACCESSORIES**

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
1. Hooks: Two, 0.06 inch stainless steel rag hooks at shelf front.
  2. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
  3. Length: 36 inches.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. Verify that field measurements are as indicated on drawings.

### **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. 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**



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**SECTION 104400  
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 2013a (Reapproved 2017).
- B. FM (AG) - FM Approval Guide current edition.
- C. NFPA 10 - Standard for Portable Fire Extinguishers 2022.
- D. UL (DIR) - Online Certifications Directory Current Edition.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

**1.04 QUALITY ASSURANCE**

- A. Fire extinguisher cabinets must comply with CBC Sections 11B-307, 11B-308, 11B-309 and 11B-403.

**1.05 FIELD CONDITIONS**

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Fire Extinguishers:
  - 1. Ansul, a Tyco Business; Cleanguard: [www.ansul.com/#sle](http://www.ansul.com/#sle).
  - 2. Kidde, a unit of United Technologies Corp: [www.kidde.com/#sle](http://www.kidde.com/#sle).
  - 3. Nystrom, Inc: [www.nystrom.com/#sle](http://www.nystrom.com/#sle).
  - 4. Oval Brand Fire Products; Oval Dry Chemical Fire Extinguisher - Multipurpose ABC: [www.ovalfireproducts.com/#sle](http://www.ovalfireproducts.com/#sle).
  - 5. JL Industries, Inc; : [www.jlindustries.com](http://www.jlindustries.com).
  - 6. Kidde Residential and Commercial Division, Subsidiary of Kidde plc; ; [www.kidde.com](http://www.kidde.com)
  - 7. Larsen's Manufacturing Co; : [www.larsensmfg.com](http://www.larsensmfg.com).
  - 8. Potter-Roemer; : [www.potterroemer.com](http://www.potterroemer.com).
  - 9. Pyro-Chem, a Tyco Business: [www.pyrochem.com/#sle](http://www.pyrochem.com/#sle).
- B. Fire Extinguisher Cabinets and Accessories:
  - 1. Activar Construction Products Group - JL Industries: [www.activarcpg.com/#sle](http://www.activarcpg.com/#sle).
  - 2. Ansul, a Tyco Business: [www.ansul.com/#sle](http://www.ansul.com/#sle).
  - 3. Kidde, a unit of United Technologies Corp: [www.kidde.com/#sle](http://www.kidde.com/#sle).
  - 4. Kidde Residential and Commercial Division, Subsidiary of Kidde plc; : [www.kidde.com](http://www.kidde.com)
  - 5. Larsen's Manufacturing Co: [www.larsensmfg.com/#sle](http://www.larsensmfg.com/#sle).
  - 6. Nystrom, Inc: [www.nystrom.com/#sle](http://www.nystrom.com/#sle).
  - 7. Oval Brand Fire Products; Cabinets for Low Profile Extinguishers: [www.ovalfireproducts.com/#sle](http://www.ovalfireproducts.com/#sle).
  - 8. Potter-Roemer: [www.potterroemer.com/#sle](http://www.potterroemer.com/#sle).

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9. Pyro-Chem, a Tyco Business: [www.pyrochem.com/#sle](http://www.pyrochem.com/#sle).

## 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. Cartridge Operated: Spun shell.
  - 2. Class: A:B:C type.
  - 3. Size: 10 pound.
  - 4. Size and classification as scheduled.
  - 5. Finish: Baked polyester powder coat, color as selected.
  - 6. Temperature range: Minus 65 degrees F to [ ] degrees F.

## 2.03 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Cabinet Construction: Non-fire rated.
  - 1. Formed primed steel sheet; 0.036 inch thick base metal.
- C. Fire Rated Cabinet Construction: One-hour fire rated.
  - 1. Steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
- D. Construction: Non-rated.
- E. Cabinet Configuration: Semi-recessed type.
  - 1. Size to accommodate accessories.
  - 2. Trim: Flat square edge, with [ ] inch wide face.
  - 3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
- F. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinge.
- G. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.
- H. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- I. Weld, fill, and grind components smooth.
- J. Finish of Cabinet Exterior Trim and Door: No. 4 - Brushed stainless steel.
- K. Finish of Cabinet Interior: White colored enamel.
- L. 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. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Lettering: FIRE EXTINGUISHER decal, or vinyl self-adhering, pre-spaced black lettering in accordance with authorities having jurisdiction (AHJ).

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

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### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, [\_\_\_\_] inches from finished floor to inside bottom of cabinet.
- C. Secure rigidly in place.
- D. Place extinguishers in cabinets.

**END OF SECTION**

**SECTION 105113  
METAL LOCKERS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Metal lockers.
- B. Locker benches.

**1.02 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2022a.
- C. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.
- D. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

**1.03 SUBMITTALS**

- A. See Section 013000 - 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. Manufacturer's Installation Instructions: Indicate component installation assembly.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Protect locker finish and adjacent surfaces from damage.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Metal Lockers:
  - 1. DeBourgh Manufacturing Co; Apex Series Lockers: [www.debourgh.com/#sle](http://www.debourgh.com/#sle).
  - 2. Lyon Workspace Products: [www.lyonworkspace.com/#sle](http://www.lyonworkspace.com/#sle).
  - 3. Penco Products, Inc: [www.pencoproducts.com/#sle](http://www.pencoproducts.com/#sle).
  - 4. Republic Storage Systems Co: [www.republicstorage.com/#sle](http://www.republicstorage.com/#sle).

**2.02 LOCKER APPLICATIONS**

- A. Student Lockers: Metal lockers, free-standing for base indicated on drawings.
  - 1. Configuration: As indicat
  - 2. Fittings: Size and configuration as indicated on drawings.
    - a. Hooks: One single prong.
  - 3. Ventilation: Louvers at top and bottom of door panel.
  - 4. Locking: Padlock hasps, for padlocks provided by Owner.

**2.03 METAL LOCKERS**

- A. Accessibility: Design units indicated on drawings as 'accessible' to comply with ICC A117.1 and ADA Standards.
- B. Locker Case Construction:
  - 1. Heavy-Duty, Welded Construction: Made of formed and welded together sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
    - a. Assembly: Do not use bolts, screws, or rivets to assemble locker bodies.
    - b. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:

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- 1) Unperforated Steel Sheet: Commercial Steel (CS), Type B, supplied for exposed applications and complying with ASTM A1008/A1008M and the following:
  - c. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
    - 1) Door Frame: 16 gauge, 0.0598 inch, minimum.
  - d. Where ends or sides are exposed, provide flush panel closures.
  - e. Provide filler strips where indicated or required, securely attached to lockers.
- C. Doors: Channel edge; welded construction, manufacturer's standard stiffeners, grind and finish edges smooth.
  1. Door Thickness: 16 gauge, 0.0598 inch, minimum.
  2. Form recess for operating handle and locking device.
- D. Latches and Door Handles: Manufacturer's standard.
  1. Latching Components: 300 Series Stainless Steel (ASTM A240/A240M).
  2. Latching: Manufacturer's standard for locking arrangement selected.
    - a. Three-Point Lift Handle Gravity Latch: Pocket-mounted, provide for doors 18 inches or taller.
      - 1) Handle Pocket, Recess: Stainless steel flush-mounted cup recessed into face of door.
      - 2) Handle: Steel finger lift mechanism with exposed portion encased in molded plastic trigger.
        - (a) Padlock Eye: Integral with lift trigger, sized for use with 9/32 inch diameter padlock shackles.
      - 3) Rubber bumpers riveted to door stops for silent operation.
- E. Hinges: Heavy-duty, 7-knuckle type; two for doors under 42 inches high; three for doors over 42 inches high.
- F. Trim: 20 gauge, 0.0359 inch.
- G. Coat Hooks: Stainless steel or zinc-plated steel.
- H. Number Plates: Provide oval shaped aluminum plates. Form numbers [ ] inch high of block font style with ADA designation, in contrasting color.
- I. Locks: Locker manufacturer's standard type indicated in Applications article above.

## 2.04 LOCKER BENCHES

- A. Locker Benches: Stationary type; bench top of laminated birch; painted steel pedestals.
  1. Accessibility: Comply with ICC A117.1 and ADA Standards.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that prepared bases are in correct position and configuration.
- B. Verify bases and embedded anchors are properly sized.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Bolt adjoining locker units together to provide rigid installation.
- E. Install end panels and filler panels.
- F. Install fittings if not factory installed.
- G. Replace components that do not operate smoothly.

### 3.03 CLEANING

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A. Clean locker interiors and exterior surfaces.

**END OF SECTION**

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**SECTION 115213  
PROJECTION SCREENS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Front projection screen assemblies.

**1.02 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's catalog cuts and descriptive information on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- C. Shop Drawings: For custom installations, indicate dimensions, verified field measurements, mounting details, and interface with adjacent construction.
- D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

**1.03 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver projection screens to project site in manufacturer's original unopened packaging, and inspect for damage and proper size before accepting delivery.
- B. Store in a protected, clean, dry area with temperature maintained above 50 degrees F, and stack in accordance with manufacturer's recommendations.
- C. Acclimate screens to building temperatures for 24 hours prior to installation, in accordance with manufacturer's recommendations.

**1.05 FIELD CONDITIONS**

- A. Maintain interior of building between 60 degrees F and [ ] degrees F during and after installation of projection screens.

**1.06 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide [ ] year manufacturer warranty for projection screen assembly.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Da-Lite Screen Company: [www.da-lite.com/#sle](http://www.da-lite.com/#sle).
- B. Draper, Inc: [www.draperinc.com/#sle](http://www.draperinc.com/#sle).

**2.02 FRONT PROJECTION SCREENS**

- A. Manufacturers:
  - 1. Da-Lite Screen Company: [www.da-lite.com/#sle](http://www.da-lite.com/#sle).
  - 2. Draper, Inc (Motorized); Premier: [www.draperinc.com/#sle](http://www.draperinc.com/#sle).
  - 3. Draper, Inc (Manual); Luma Series: [www.draperinc.com/#sle](http://www.draperinc.com/#sle).
- B. Front Projection Screens: Factory assembled unless otherwise indicated.
  - 1. Dimensions: As indicated on drawings.

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- 2. In Classrooms: Manual, matte light diffusing fabric screen, horizontally tensioned, wall mounted.
- C. Matte Light Diffusing Fabric: Light diffusing screen fabric; washable, flame retardant and mildew resistant.
  - 1. Material: Matte white vinyl on fiberglass backing, with nominal gain of 1.0 over viewing angle not less than 70 degrees from axis, horizontally and vertically.
- D. Masking Borders: Black, on four sides.
- E. Exposed Screen Cases: Steel, with integral roller brackets.
  - 1. Finish: Baked enamel.
  - 2. Color: White.
  - 3. End Caps: Steel; finished to match case.
  - 4. Provide supports for suspension from ceiling where indicated.
  - 5. Mounting: Wall.
- F. Manually-Operated Screens:
  - 1. Roller: 1-3/4 inch aluminum; spring loaded with locking device.
  - 2. Screen Pull: Ring on bottom bar.
  - 3. Vertical Tensioning: Screen fabric weighted at bottom with steel bar and plastic end caps.
  - 4. Horizontal Tensioning: Tensioning bar.
- G. Provide mounting hardware, brackets, supports, fasteners, and other mounting accessories required for a complete installation, in accordance with manufacturer's recommendations for specified substrates and mountings.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that substrate is finished and ready to accept screen installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Do not install projection screens until climate control systems are in place and interior painting and other finishes are completed.

#### **3.02 PREPARATION**

- A. Coordinate screen installation with installation of projection systems.
- B. Coordinate installation with adjacent construction and fixtures, including ceilings, walls, lighting, fire suppression, and registers and grilles.

#### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions, using manufacturer's recommended hardware for relevant substrates.
- B. Do not field cut screens.
- C. Install screens in mountings as specified and as indicated on drawings.
- D. Install plumb and level.
- E. Adjust projection screens and related hardware in accordance with manufacturer's instructions for proper placement and operation.

#### **3.04 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch up, repair, or replace damaged products before Date of Substantial Completion.

**END OF SECTION**



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**SECTION 115313  
LABORATORY FUME HOODS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Standard laboratory fume hoods.
- B. Fume hood base cabinets and stands.
- C. Work surfaces.
- D. Laboratory cup sinks in fume hoods.
- E. Service fittings and outlets.
- F. Airflow indicators and alarms.

**1.02 REFERENCE STANDARDS**

- A. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods 2016, with Errata.
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2022a.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- 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 2021a.
- E. SEFA 1 - Laboratory Fume Hoods 2010.
- F. UL 1805 - Standard for Safety Laboratory Fume Hoods and Cabinets 2006.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate installation of fume hoods with laboratory casework and other laboratory equipment.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide fume hood exterior and interior dimensions and construction, utility and service requirements and locations.
- C. Shop Drawings: Indicate locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, clearances required, locations and types of service fittings.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. Provide documentation of successful Factory Acceptance Testing.
- E. Operation Data: Include description of equipment operation and required adjusting and testing.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Project Record Documents: Record actual locations of concealed utility connections.

**1.05 QUALITY ASSURANCE**

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

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- C. Preconstruction Testing: Factory-test each type of hood as per referenced standard.

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

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

#### **1.07 FIELD CONDITIONS**

- A. Ambient Conditions: Maintain temperature and relative humidity at occupancy levels during and after installation of fume hoods.

#### **1.08 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide one year manufacturer warranty for manufacturer's standard items (listed by part number in manufacturer's official publication).

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Metal Laboratory Fume Hoods:
  1. Mott Manufacturing Ltd: [www.mott.ca/#sle](http://www.mott.ca/#sle).
- B. Provide laboratory fume hoods from same manufacturer as laboratory casework.

#### **2.02 PERFORMANCE REQUIREMENTS**

- A. Fume hoods complying with the following when tested in accordance with ASHRAE Std 110:
  1. As-Manufactured (AM) Rating: AM 0.01 (0.01 ppm).
  2. As-Installed (AI) Rating: AI 0.10 (0.10 ppm).
  3. Average Face Velocity: 100 FPM (0.51 m/s) plus or minus 10 percent with sashes fully open.
  4. Face-Velocity Variation: Not more than 10 percent of average face velocity across the face opening with sash(es) fully open.
  5. Release Rate: 4.0 L/min.
  6. Static-Pressure Loss: Not more than 1/2-inch w.g. (124 Pa) at 100 FPM (0.51 m/s) face velocity with sash fully open when measured at four locations 90 degrees apart around the exhaust duct and at least three duct diameters downstream from duct collar.

#### **2.03 FUME HOODS**

- A. General Requirements:
  1. Comply with SEFA 1.
    - a. Provide fume hoods UL listed and labeled for compliance with UL 1805.
- B. Fume Hood:
  1. Ventilation: Variable Air Volume (VAV).
  2. Configuration: Standing-height; bench mounted.
  3. Nominal Interior Height: 48 inches.
  4. Sash Type: Vertical rising.
    - a. Leak-free enclosure box, manufacturer's standard construction, for vertical rising sash.
    - b. Glazing: Laminated safety glass.
    - c. Sash Guides: Corrosion-resistant polyvinyl chloride (PVC) track.
    - d. Vertical Sash mechanism: Designed to prevent sash drop in case of mechanism failure.
      - 1) Cable: Minimum 3/32 inch (2 mm) thick stainless steel of construction standard with the manufacturer.
    - e. Vertical Sash Pull: Type 316 stainless steel, with No.4 finish.

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5. Top Front Panel: Standard integral grille stamped into panel of same materials as fume hood exterior.
  6. Exterior: Sheet steel.
  7. Interior Lining: Polypropylene.
  8. Service Fittings and Fixtures:
    - a. Cup Sink : Drop-in Epoxy, complete with removable stainer and waste fitting, side-mounted at floor-mounted fume hood.
      - 1) Shape: Round.
      - 2) Size: 5 inch (127mm) diameter.
    - b. Natural Gas Fitting Assembly
  9. Access Panels: Provide removable panels on both sides hood exterior and interior lining panels.
  10. Work Surface:
    - a. Work Top for Fume Hoods Other Than Floor-mounted Type: Epoxy resin.
      - 1) Edge: Raised rim with rounded edges and corners.
- C. Fume Hood Base Cabinets:
1. Exterior construction: Wood Cabinets.
    - a. Standard storage cabinets.
  2. Material: Sheet steel.
  3. Color/Finish: As indicated on drawings.
- D. Light Fixtures: UL labeled, vaporproof, one-tube, T-5 fluorescent light fixtures. Number and length of fixtures as necessary for fume hood width. Mounted above sealed safety glass panel. White baked-enamel finish on fixture interior.

## 2.04 FABRICATION

- A. General: Assemble fume hoods in factory to greatest extent possible. Disassemble fume hoods only as necessary for shipping and handling limitations, or as necessary to permit movement through a 35 inches by 79 inches clear door opening.
- B. Steel Exterior: Fabricated from steel sheet, 0.048 inch thick, with component parts screwed together to allow removal of end panels, front fascia, and airfoil and to allow access to plumbing lines and service fittings. Chemical-resistant finish applied to interior and exterior surfaces of component parts before assembly.
- C. Ends: Fabricated with double-wall end panels. Close area between double walls at front of fume hood and as needed to house sash counterbalance weights, utility lines, and remote-control valves.
- D. Lining Assembly: Unless otherwise indicated, assembled with stainless-steel fasteners or epoxy adhesive, concealed where possible. Joints sealed by filling with chemical-resistant sealant during assembly.
  1. Punched fume hood lining side panels for service fittings and remote controls. Removable plug buttons for holes not used for indicated fittings.
- E. Rear Baffle: Same material as fume hood lining, unless otherwise indicated, at rear of hood with openings at top and bottom, with corrosion-resistant fasteners. Fabricated for removal to facilitate cleaning behind baffle.
- F. Exhaust Plenum: Full width of fume hood, sized and configured to provide uniform airflow, of same material as hood lining, and with duct stub for exhaust connection.
  1. Duct-Stub Material: Epoxy-coated steel, unless otherwise indicated.
- G. Airfoil: At bottom of fume hood face opening, with 1 inch gap between bottom of airfoil and work top. Sash to close on top of airfoil. Designed to direct airflow across work.
  1. Fabricated from 14 gauge, 0.0781 inch stainless steel with No.4 finish.
- H. Ceiling Extensions: Filler panels matching fume hood exterior to enclose space above fume hoods at front and sides of fume hoods, and extending from tops of fume hoods to approximately 4 inches (102 mm) above ceiling. Flange, notch, and reinforce ceiling

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extensions as required for rigidity. Fabricate to form well-fitting closures, free from oil-canning.

- I. Comply with requirements of other sections for factory installation of water and laboratory gas service fittings, piping, electrical devices, and wiring. Securely anchor fittings, piping, and conduit to fume hoods, unless otherwise indicated.

## 2.05 MATERIALS

- A. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A1008/A1008M; matte finish; suitable for exposed applications.
- B. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Fasteners: Stainless-steel, where exposed to fumes.

## 2.06 ACCESSORIES

- A. Airflow Monitors/Indicators and Alarms: Provide each fume hood with a airflow monitor/indicator complete with an audible and visual alarm that activates when airflow sensor reading is outside of preset range.
  1. Source: Fume hood manufacturer.
  2. Airflow Monitor/Indicator Functionality:
  3. Airflow Alarm functionality: Audible (85 dB @ 4 inch distance), and visual alarm that activates when airflow sensor reading is outside of preset range.
    - a. Reset and test mode.
    - b. Programmable Switch: Designed to silence audible alarm and automatically reset when airflow returns to within preset range. Warning light to stay on when alarm is silenced.
    - c. Capability for integration with BAS (Building Automation System) via BACnet.

## 2.07 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Factory testing of each type of fume hood.
- C. Non-Complying Work: See Section 014000.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Locate concealed framing, blocking, and reinforcements that support fume hoods by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- B. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fume hoods.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. General: Install fume hoods according to manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework. Securely attach access panels but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Large Components: Ensure that large components can be moved into final position without damage to other construction.
- C. Comply with indicated requirements for installing water and laboratory gas service fittings, and electrical and telecommunications devices.

### 3.03 FIELD QUALITY CONTROL

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- A. Field test fume hoods as specified below.
1. General: Test fume hoods as installed to assess airflow velocity. Perform tests with static mode (set sash position) conditions. Conduct testing as outlined below for 100% of the hoods provided in the Project.
  2. Preparation:
    - a. Inspect each fume hood to confirm its installation complies with drawings and specifications.
    - b. Inspect laboratory space to verify that construction complies with drawings and specified requirements.
    - c. Do not proceed with fume hood testing until an acceptable TAB report has been received.
    - d. Verify that proper temperature and pressurization of the lab space can be maintained, with door(s) to the space in closed and open positions.
    - e. Adjust non-complying physical and control systems until conditions favorable to testing fume hoods are present.
  3. Operating Conditions Tests:
    - a. Conduct face velocity tests to confirm that target velocities are being achieved within acceptable tolerances.
    - b. Conduct airflow indicator/monitor tests to confirm acceptable variation from corresponding measured value. Calibrate and adjust device to function within specified accuracy parameters.
    - c. Conduct exhaust flow and static pressure tests of the HVAC system and its controls to confirm flow volume and static pressures are within acceptable tolerances.
    - d. Conduct tests of alarm device by shutting off the fume hood exhaust and verify that the individual fume hood alarm activates and operates in specified manner.
    - e. Conduct tests of individual controls provided at the fume hood (such as unoccupied cycle override, alarm override, etc.) to verify they operate in specified manner.
  4. Containment Performance Tests:
    - a. Conduct airflow visualization tests (local smoke challenges) to provide a visual indication of fume hood's capture performance.
      - 1) Coordinate disabling of local fire alarm system when performing this test.
      - 2) Compensate for smoke discharge velocity and exposure outside of the fume hood.
      - 3) If required to be performed, do not proceed with the large volume challenge test if the hood has failed the local challenge test.

### **3.04 ADJUSTING**

- A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand only. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.

### **3.05 CLEANING**

- A. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

### **3.06 DEMONSTRATION**

- A. Demonstrate proper operation of fume hoods and their accessories to Owner's designated representative.

**END OF SECTION**

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**SECTION 116833  
ATHLETIC FIELD EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Baseball and softball field equipment.

**1.02 RELATED REQUIREMENTS**

- A. Section 033000 - Cast-in-Place Concrete: Footings for field equipment.
- B. Section 312200 - Grading: Shaping subgrade to specified grade levels; removal of excess soil and rocks.

**1.03 ABBREVIATIONS**

- A. NFHS - National Federation of State High School Associations; www.nfhs.com and www.nfhs.org.
- B. U.S. CPSC - United States Consumer Product Safety Commission; www.cpsc.gov.

**1.04 REFERENCE STANDARDS**

- A. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe 2021.
- B. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.
- C. ASTM A513/A513M - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing 2020a.
- D. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete 2022a.
- E. ASTM D3363 - Standard Test Method for Film Hardness by Pencil Test 2022.

**1.05 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meetings: Convene a meeting one week before starting this work to discuss coordination between various installers.
  - 1. Require attendance by personnel responsible for grading and installers of athletic field equipment, footings, and adjacent work.
  - 2. Include representatives of Contractor.
  - 3. Notify Architect at least two weeks prior to meeting.

**1.06 SUBMITTALS**

- A. Product Data: Provide athletic field equipment manufacturer's product data indicating materials of construction, compliance with specified standards, installation procedures, and necessary safety limitations.
- B. Shop Drawings: Submit detailed scale drawings showing athletic field equipment and perimeter layout.
  - 1. Indicate locations and dimensions of footings and anchorage points.
  - 2. Identify mounting elevations in relation to fixed survey point on site, and subgrade elevation.
  - 3. Indicate location of underground utilities, storm drainage system, and irrigation system.
  - 4. Indicate location of related construction such as walkways and roadways, fences, [\_\_\_\_], and site furnishings.
- C. Maintenance Data: Submit manufacturer's recommended maintenance instructions and list of replaceable parts for each athletic field equipment item, along with supplier's address and phone number.
- D. Installer's Qualification Statement.
- E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

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### 1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience

### 1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store equipment on project site in accordance with manufacturer's recommendations.
- B. Store materials in a dry, covered area, and elevated above grade.

### 1.09 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Athletic Field Equipment:
  - 1. Sportsfield Specialties, (888) 975-3343

### 2.02 ATHLETIC FIELD EQUIPMENT - GENERAL

- A. High School Sports: Provide equipment that complies with NFHS requirements.
- B. Coordinate field grading as required for proper placement and arrangement of equipment, refer to Section 312200 for additional information.
- C. Safety and Warning Signage: Provide signage as indicated on drawings and required by authorities having jurisdiction.

### 2.03 BASEBALL AND SOFTBALL FIELD EQUIPMENT

- A. Manufacturers:
  - 1. Sportsfield Specialties, (888) 975-3343.
- B. Netting System:
  - 1. Type: Tension system
  - 2. Height: 50 feet

### 2.04 MATERIALS

- A. Steel Pipe columns
  - 1. HSS 10.75 x 0.365
  - 2. Height: 50 feet
  - 3. Refer to SportsField Specialties sheets for more information
- B. Powder Coating for Steel: Electrostatically applied and oven cured polyester powder over electrostatic zinc coating. Color: Black
- C. Concrete: ASTM C94/C94M ready mix concrete; 28 days strength of 4500 psi.
  - 1. Refer to SportsField Specialties sheets for more information.

## PART 3 EXECUTION

### 3.01 VERIFICATION OF CONDITIONS

- A. Verify that athletic field equipment area has been graded to subgrade elevations required and that excess soil, rocks, and debris has been removed as necessary for installation of footings.

### 3.02 PREPARATION

- A. Stake location of athletic field equipment elements, including necessary athletic field perimeters, surfacing, access and egress points, hard surfaces, walls, fences, [\_\_\_\_], and/or structures.

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- B. Stake layout of athletic field equipment perimeter in accordance with approved shop drawings before starting any work.
  - 1. Verify that athletic field perimeters do not overlap hard surfaces, whether currently installed or not.
  - 2. Verify that athletic fields are free of obstructions.
  - 3. If conflicts or obstructions are found, notify Architect.
  - 4. Do not proceed with this work until revised drawings have been provided, showing corrected layout, and that any obstructions have been removed or corrections to layout have been made.

**3.03 INSTALLATION**

- A. Install athletic field equipment in accordance with manufacturer's instructions, and rules and regulations of specified athletic association indicated for this work.
- B. Install athletic field equipment without sharp points, edges, or protrusions; entanglement hazards or pinch, crush, or shear points.
- C. Install safety and warning signage, as follows, in accordance with indicated requirements.

**3.04 CLEANING**

- A. Clean athletic field equipment of construction materials, dirt, stains, filings, and blemishes due to shipment or installation; clean in accordance with manufacturer's instructions, using cleaning agents as recommended by manufacturer.
- B. Clean athletic field area of excess construction materials, debris, and waste.
- C. Remove excess and waste material and dispose of off-site in accordance with requirements of authorities having jurisdiction.

**3.05 PROTECTION**

- A. Protect installed products until Date of Substantial Completion.
- B. Replace damaged products before Date of Substantial Completion.

**END OF SECTION**



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**SECTION 122400  
WINDOW SHADES - MECHOSHADE SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Manual roller shades and accessories.

**1.02 REFERENCE STANDARDS**

- A. BIFMA HCF 8.1 - Health Care Furniture Design – Guidelines for Cleanability 2019.
- B. WCMA A100.1 - Safety of Window Covering Products 2018.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Sequencing:
  1. Do not fabricate shades until field dimensions for each opening have been taken with finished conditions in place. "Hold to" dimensions are not acceptable.
  2. Do not install shades until final surface finishes and painting are complete.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product to be used including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
  1. Motorized Shades: Include power requirements and standard wiring diagrams solely for the specified products.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details.
  1. Motorized Shades: Include one-line diagrams, wire counts, coverage patterns, and physical dimensions of each item. Include location plan showing all switch and control zones, switches, sensors and other control accessories.
- D. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.
- E. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Operation and Maintenance Data: List of all components with part numbers, and operation and maintenance instructions; include copy of shop drawings.
- G. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this type with minimum ten years of documented experience with shading systems of similar size, type, and complexity; manufacturer's authorized representative.
- C. Resistance to Degradation When Exposed to Typical Cleaners: Passes BIFMA HCF 8.1 testing.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

**1.07 FIELD CONDITIONS**

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

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## 1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's standard, non-depreciating warranty, for interior shading only, covering the following:
  - 1. Shade Hardware: 10 years unless otherwise indicated.
    - a. Mecho /5 with ThermoVeil, EuroVeil, EuroTwill, Soho, Equinox, Midnite, Chelsea, or Classic Blackout shade fabric: 25 years.
  - 2. Shade Fabric: 10 years unless otherwise indicated.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Basis of Design: MechoShade Systems LLC; [www.mechoshade.com/#sle](http://www.mechoshade.com/#sle).

### 2.02 ROLLER SHADES

- A. General:
  - 1. Provide shade system components that are capable of being removed or adjusted without removing mounted shade brackets or cassette support channel.
  - 2. Provide shade system that operates smoothly when shades are raised or lowered.
- B. Roller Shades - Basis of Design: MechoShade Systems LLC; UrbanShade Single Roller - Manual; [www.mechoshade.com/#sle](http://www.mechoshade.com/#sle).
  - 1. Description: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
    - a. Drop Position: Reverse roll.
    - b. Size: As indicated on drawings.
  - 2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
    - a. Material: Stamped steel.
  - 3. Roller Tubes:
    - a. Material: Extruded aluminum.
    - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
    - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
    - d. Roller tubes to be capable of being removed and reinstalled without affecting roller shade limit adjustments.
  - 4. Hembars: Designed to maintain bottom of shade straight and flat.
    - a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
  - 5. Manual Operation:
    - a. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
      - 1) Provide brake assembly mounted on a low-friction plastic hub with wrapped spring clutch.
      - 2) Brake must withstand minimum pull force of 25 pounds in the stopped position.
      - 3) Mount clutch/brake assembly on the support brackets, fully independent of the roller tube components.
    - b. Drive Chain: Continuous loop beaded ball chain. Provide upper and lower limit stops.
      - 1) Chain must withstand a breaking force of no less than 45 pound-force.
      - 2) Chain Retainer: Chain tensioning device complying with WCMA A100.1.
  - 6. Accessories:
    - a. Fascia: Removable extruded aluminum fascia, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; clear anodized finish.

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- 1) Fascia to be capable of installation across two or more shade bands in one piece.
- 2) Color: White.
- 3) Profile: Square.
- 4) Configuration: Captured, fascia stops at captured bracket end.

### 2.03 SHADE FABRIC

- A. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
  1. Color: As indicated on plans.
  2. Fabrication:
    - a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
  3. Products:
    - a. MechoShade Systems LLC Inc; Soho - 1100 Series (1% open):  
www.mechoshade.com/#sle.

### 2.04 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
  1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
  2. Horizontal Dimensions - Outside Mounting: Cover window frames, trim, and casings completely.
- C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Start of installation shall be considered acceptance of substrates.

### 3.02 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

### 3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
- C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

### 3.04 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

### 3.05 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.

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- C. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

**3.06 PROTECTION**

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION**

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**SECTION 123553.19  
WOOD LABORATORY CASEWORK**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Custom wood cabinets and cabinet hardware.
- B. Tables.
- C. Acid storage cabinets.
- D. Solvent storage cabinets.
- E. Countertops.
- F. Laboratory sinks.
- G. Pegboards.
- H. Laboratory emergency equipment plumbing fixtures.
- I. Service fittings and outlets.

**1.02 DEFINITIONS**

- A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches above finished floor, tops of cases less than 72 inches above finished floor and all members visible in open cases or behind glass doors.
- B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches above finished floor and bottoms of cabinets more than 30 inches but less than 42 inches above finished floor.
- C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation and cabinets less than 30 inches above finished floor.

**1.03 REFERENCE STANDARDS**

- A. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment 2014.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- C. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2022.
- D. AWI (QCP) - Quality Certification Program Current Edition.
- E. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood 2020.
- F. ICC (IFC) - International Fire Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. NFPA 1 - Fire Code 2021, with Errata (2022).
- H. NFPA 30 - Flammable and Combustible Liquids Code 2021, with Amendment (2020).
- I. SEFA 1 - Laboratory Fume Hoods 2010.
- J. SEFA 2 - Installations 2010.
- K. SEFA 3 - Laboratory Work Surfaces 2010.
- L. SEFA 7 - Laboratory Fixtures 2010.
- M. SEFA 8W - Laboratory Grade Wood Casework 2016.
- N. SEFA 11 - Liquid Chemical Storage Cabinets 2019.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate installation of casework with related items.

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- B. Service Fixtures: Coordinate location and characteristics of service connections.

### 1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Component dimensions, configurations, construction details, joint details, attachments; manufacturer's catalog literature on hardware, accessories, and service fittings, if any.
- C. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements placement dimensions and tolerances, clearances required, and utility locations, if any. Include coordinated information for laboratory equipment specified in another section and/or furnished by Owner.
- D. Samples For Color Selection: Wood samples, fully finished, for color and species selection. Minimum Sample Size: 2 inches by 3 inches.
- E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- F. Test Reports: From independent laboratory indicating compliance with referenced chemical-resistance standards for cabinet finish and liner materials.
- G. Installer's Qualification Statement.
- H. Maintenance Data: Manufacturer's recommendations for care and cleaning.
- I. Finish touch-up kit for each type and color of materials provided.

### 1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.
- C. Quality Certification:
  - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: [www.awiqcp.org/#sle](http://www.awiqcp.org/#sle).
  - 2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
  - 3. Provide designated labels on shop drawings as required by certification program.
  - 4. Provide designated labels on installed products as required by certification program.
  - 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
- D. Operable parts for all accessible casework shall comply with CBC Section 11B-309.
  - 1. Provide U-shaped pulls or touch latches at all accessible casework.

### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.
- B. Acceptance at Site:
  - 1. Do not deliver or install casework until the conditions specified under Part 3, Examination Article of this section have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.
- C. Storage:

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1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the environmental requirements specified under Part 3, "Site Verification of Conditions" paragraph of this section.

### 1.08 WARRANTY

- A. Correct defective work within a five year period after Date of Substantial Completion, at no additional cost to Owner. Defects include, but are not limited to:
  1. Ruptured, cracked, or stained finish coating.
  2. Discoloration, or lack of finish integrity.
  3. Cracking or peeling of finish.
  4. Failure of hardware.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Wood Laboratory Casework:
  1. Hamilton Scientific LLC: [www.hamiltonscientific.com](http://www.hamiltonscientific.com).
  2. Kewaunee Scientific Corp: [www.kewaunee.com/#sle](http://www.kewaunee.com/#sle).
  3. Mott Manufacturing: [www.mott.ca/#sle](http://www.mott.ca/#sle).
- B. Countertops:
  1. Durcon (Epoxy resin, Solid phenolic): [www.durcon.com/#sle](http://www.durcon.com/#sle).
- C. Sinks and Cup Sinks:
  1. Durcon (Epoxy resin, Polyolefin): [www.durcon.com/#sle](http://www.durcon.com/#sle).
- D. Water and Gas Service Fittings:
  1. Broen-Lab A/S: [www.broen-lab.com/#sle](http://www.broen-lab.com/#sle).
  2. Chicago Faucets, a Geberit company: [www.chicagofaucets.com/#sle](http://www.chicagofaucets.com/#sle).
  3. WaterSaver Faucet Co: [www.wsflab.com/#sle](http://www.wsflab.com/#sle).
- E. Obtain casework from single source and manufacturer, unless otherwise indicated.

### 2.02 WOOD LABORATORY CASEWORK

- A. Wood Laboratory Casework: Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base cabinets.
  1. Style: Flush overlay. Ease doors and drawer fronts slightly at edges.
  2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
    - a. Base Cabinets: 22 inches.
    - b. Tall Cabinets: 22 inches.
    - c. Upper Cabinets: 16 inches.
  3. Construction: Joints doweled, glued and screwed, except drawers may be lock-shoulder jointed; with interior of units smooth and flush; cabinet bottom flush with top of face frame; without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
  4. Structural Performance: In addition to the requirements of SEFA 3, SEFA 7, and SEFA 8W, components safely support the following minimum loads:
  5. Fittings and Fixture Locations: Cut and drill counter tops, backs, and other components for service outlets and fixtures.
  6. Fixed panels at backs of open spaces between base cabinets and at ends of utility spaces not otherwise enclosed.
    - a. Cutouts for power receptacles where indicated on drawings.
  7. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
  8. Factory-finish all exposed and semi-exposed surfaces with the same finish.

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- a. Finish Performance: Provide finish on all surfaces having chemical resistance of Level 0 (no change) or Level 1 (slight change of gloss or slight discoloration) according to SEFA 8W and no visible effect when surface is exposed to:
    - 1) Hot water at temperature between 190 degrees F and 205 degrees F trickled down the test surface at 45 degree angle for 5 minutes.
    - 2) Constant moisture in the form of 2 by 3 by 1 inch thick cellulose sponge kept continually saturated with water and in contact with test surface for 100 hours.
  - b. Preparation: Wood sanded smooth, free from dust and mill marks.
  - c. Coating: Clear, superior-quality, chemical-resistant acyclic urethane; applied in accordance with manufacturer instructions, force-dried, sanded and wiped clean.
  - d. Coats: Multiple coats as required to achieve minimum 1.5 mil dry film thickness.
  - e. Appearance: Clear satin gloss; not cloudy or muddy.
- B. Acid Storage Cabinets:
1. Completely lined with corrosion-resistant liner material; stainless steel fasteners for all connections and hardware inside cabinets.
  2. Shelves: Removable, same material as cabinet, covered with corrosion-resistant liner.
  3. Bottom Pan: Liquid-tight liner covering entire bottom of acid-storage cabinet.
  4. Vents: Comply with SEFA 1.
    - a. Locate acid-storage cabinet vents in accordance with manufacturer's instructions.
- C. Solvent (Flammable and Combustible Liquids) Storage Cabinets: Construction identical to other cabinets, with following exceptions:
1. Construct to NFPA 30 and applicable OSHA requirements.
  2. Comply with SEFA 11.
  3. Fire Resistance: Maximum internal temperature of 325 degrees F at the center, and 1 inch from top of the cabinet when cabinet is subjected to a ten minute fire test that simulates fire exposure of a standard time-temperature curve specified in ASTM E119.
  4. Shelves: Full depth, adjustable.
  5. Bottom Pan: 2 inches deep, liquid-tight pan covering entire bottom of cabinet.
  6. Cabinet Hardware: UL-listed.
    - a. Hinges: Full-length stainless steel continuous (piano) hinges.
    - b. Self-closing Doors: Comply with requirements of NFPA 1 and ICC (IFC). Minimum 90 degree opening. Three-point latch arrangement, door(s) shutting and latching automatically when hold-open device's fusible link melts at 165 degrees F under fire conditions outside the cabinet. At pair of doors, synchronize latching so that both doors always fully close.
    - c. Door Handles: Manufacturer's standard, with slip-resistant grip.
      - 1) Provide manufacturer's standard cylinder lock and key set.
  7. Vents: Provide venting capable of achieving ten air changes per hour.
    - a. Tie into building hazardous exhaust system.
    - b. Vent Connections: 1-1/2 inch minimum diameter, corrosion-resistant piping having flame spread index of 25 or less when tested in accordance with ASTM E84.
    - c. Vent each cabinet separately with sufficient mixing distance for incompatible chemicals.
    - d. Provide minimum of two vents with fire arrestor for each cabinet.
  8. Signage: Provide manufacturer's standard signage reading "FLAMMABLE - KEEP FIRE AWAY" or similar message in bright red color.
- D. Tables: With standard aprons manufactured of not less than 3/4 by 3 1/2 inch solid lumber, machined to receive corner blocks, and bolted to 2 1/8 by 2 1/8 inch solid hardwood legs. 3/8 inch leveling devices, and slip-on type black PVC shoes.
1. Mobile tables constructed the same as standard laboratory tables, except with table legs designed to receive swivel casters.
    - a. Caster wheels of non-marring type urethane tires in gray or black color.
- E. Wall Shelving: At locations indicated.



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1. Adjustable Shelf Supports: Standard back-mounted system using single-slotted surface mounted stainless steel shelf standards, in lengths indicated, with coordinated cantilevered shelf brackets, no.4 finish, designed for nominal 1 inch spacing adjustments.

### **2.03 CABINET HARDWARE**

- A. Manufacturer's standard styles, and as indicated below.
- B. Conform to BHMA A156.9 requirements.
- C. Finish of exposed stainless steel components: No.4 finish.
- D. Locks: Provide locks on casework drawers and doors where indicated. Lock with 5 pin cylinder and 2 keys per lock.
  1. Hinged Doors: Cam type lock, 625 finish.
  2. Framed Sliding Doors: Plunger-type sliding showcase lock, 626 finish.
  3. Keying: Key locks alike within a space; key each room separately.
  4. Master Key System: All locks operable by master key.
- E. Shelves in Cabinets:
  1. Shelf Standards and Rests: Vertical standards with rubber button fitted rests, satin chromium plated over nickel on base material.
- F. Swinging Doors:
  1. Hinges: Offset pin.
    - a. European-Style Hinges: For overlay doors, concealed. Steel, nickel-plated, 110 degree opening angle.
  2. Catches: Magnetic.
  3. Pulls: Chrome wire pulls, 4 inches wide.
  4. Sliding Doors:
    - a. Pulls: Steel, recessed circular design.
      - 1) Steel Finish: 625, bright chromium plated.
    - b. Track Assembly: Nylon track with solid bearing followers.
  5. Drawers:
    - a. Pulls: Chrome wire pulls, 4 inches wide.
    - b. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.

### **2.04 COUNTERTOPS**

- A. Countertops: As specified in Section 123600.

### **2.05 PEGBOARDS**

- A. Epoxy pegboards with pre-drilled or punched holes in a staggered pattern, designed to accept removable white polypropylene pegs. With each pegboard include a stainless steel drip-trough with drain outlet and matching diameter 36 inches long PVC drain hose.
  1. Size: 30 inches wide by 30 inches high.

### **2.06 LABORATORY EMERGENCY EQUIPMENT PLUMBING FIXTURES**

- A. General: Provide emergency equipment products complying with requirements of ANSI Z358.1.
- B. Eyewash/Safety Shower Combination Units: Recessed into wall construction.
  1. Cover/Eyewash Drain Pan: Combination fixture, with projecting activation handle requiring grasping and pulling down into operating position for activation.
  2. Shower Head: 10 inch diameter stainless steel, with 20 gallons per minute flow control.
    - a. Mounting: Below finished ceiling. Include vertical supply pipe and ceiling escutcheon.
    - b. Offset Dimension from Wall to Centerline of Head: 36 inches, barrier-free.
  3. Activation Handle: Recessed into cabinet, projecting 1-7/8 inches maximum beyond face of wall, and requiring pushing down for activation.

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- a. Grip: Manufacturer's standard vinyl grip.

## 2.07 SERVICE FITTINGS

- A. General: Comply with requirements of SEFA 7.
- B. Gas Service Fittings and Fixtures:
  - 1. Laboratory Gas Fitting :
    - a. Valve: Forged or cast brass body, 90 degree inlet - outlet configuration, with polished chrome with clear epoxy coating finish.
    - b. Control: Ball valve.
    - c. Mounting: Panel (vertical surface).
    - d. Supply Gas: Natural Gas.
    - e. Inlet: 3/8 inch NPS NPT.
    - f. Outlet: Manufacturer's standard, with removable seven-serration hose end.
      - 1) Number: One.
    - g. Handle: Manufacturer's standard four-arm Handle with color-coded index disc.
- C. Electrical Fittings and Fixtures:
  - 1. Electrical Fittings, General: Types indicated, for mounting on laboratory casework, including, as appropriate, grounding screws, and mounting accessories and fasteners.
  - 2. Electrical Power Fitting :
    - a. General: 3-wire polarized receptacles, aluminum with metallic finish pedestal and line-type boxes; plated steel recessed boxes, meeting requirements of NFPA 70.
    - b. Mounting: Pedestal, surface-mounted.
    - c. Receptacles: Duplex, 5-20R, GFCI.
    - d. Twist-Lock Receptacles: Single, L6-20R, GFCI.
    - e. Orientation: Single face.
    - f. Service: Normal power.
    - g. See electrical drawings for circuiting.

## 2.08 MATERIALS

- A. Wood-Based Materials:
  - 1. Solid Wood: Air-dried to 4.5 percent moisture content, then tempered to 6 percent moisture content before use.
  - 2. Composite Wood Panels: Containing no urea-formaldehyde resin binders.
- B. Exposed Solid Wood: Clear, dry, sound, plain sawn, selected for compatible grain and color, no defects.
- C. Exposed Hardwood Plywood: Veneer core; HPVA HP-1 Grade AA, Type I; same species as exposed solid wood, clear, compatible grain and color, no defects. Band exposed edges with solid wood of same species as veneer.
- D. Semi-Exposed Solid Wood: Dry, sound, plain sawn, no appearance defects, any species similar in color and grain to exposed portions.
- E. Semi-Exposed Hardwood Plywood: Veneer core; HPVA HP-1 Grade C, Type I; plain sliced, any species similar in color and grain to exposed portions.
- F. Concealed Solid Wood or Plywood: Any species and without defects affecting strength or utility.
- G. Solid Epoxy Resin: Modified epoxy resin and non-asbestos inert fillers cast into sheets.
- H. Glass: Fully tempered float; ASTM C1036, Type 1, Quality Q3; ASTM C1048, tempered using horizontal tempering and complying with ANSI Z97.1; 4 mm thick minimum; exposed edges ground, and cut or drilled to receive hardware; clear.
- I. Solvent-Resistant Liner Material: High-density, asbestos-free, non-combustible, calcium-silicate-based panel consisting of autoclaved Portland cement, mineral fillers and synthetic fibers.

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- J. Sealant for Use in Casework Construction: Manufacturer's recommended type.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Site Verification of Environmental Conditions:
1. Do not deliver casework until the following conditions have been met:
    - a. Building has been enclosed (windows and doors sealed and weather-tight).
    - b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
    - c. Ceiling, overhead ductwork, piping, and lighting have been installed.
    - d. Installation areas do not require further "wet work" construction.
- B. Verify adequacy of support framing and anchors.
- C. Verify that service connections are correctly located and of proper characteristics.

#### **3.02 INSTALLATION**

- A. Perform installation in accordance with manufacturer's instructions and with SEFA 2.
- B. Large Components: Ensure that large components can be moved into final position without damage to other construction.
- C. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
- D. Set casework items plumb and square, securely anchored to building structure.
1. Base Cabinets: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 3/4 inch leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.
  2. Wall Cabinets: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
    - a. Maximum variation from plane of masonry wall exceeds 1/4 inch in 10 ft and 1/2 inch in 20 ft or more, and/or maximum variation from plumb exceeds 1/4 inch per story.
    - b. Maximum Variation of finished gypsum board surface from true flatness exceeds 1/8 inch in 10 feet in any direction.
- E. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
- F. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:
1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
  2. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
  3. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
  4. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
- G. Secure upper and floor cabinets to concealed reinforcement at gypsum board assemblies.
- H. Separate dissimilar metals to prevent galvanic action.
- I. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- J. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
- K. Vented Cabinets: Install in strict compliance with manufacturer's written installation instructions.
1. Install vent kits and connect to fume hood exhaust system.

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2. Use only rigid materials for venting. No flexible materials permitted.

L. Countertops: Install countertops in one true plane, with ends abutting at hairline joints, and no raised edges.

M. Replace units that are damaged, including those that have damaged finishes.

### **3.03 ADJUSTING**

A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

### **3.04 CLEANING**

A. Clean casework and other installed surfaces thoroughly.

### **3.05 PROTECTION**

A. Do not permit finished casework to be exposed to continued construction activity.

B. Protect casework and countertops from ongoing construction activities. Prevent installers from standing on or storing tools and materials on casework or countertops.

C. Repair damage that occurs prior to Date of Substantial Completion, including finishes, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

**END OF SECTION**

## SECTION 123600 COUNTERTOPS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Countertops for architectural cabinet work.
- B. Wall-hung counters and vanity tops.
- C. Sinks molded into countertops.
- D. Epoxy resin sinks.

#### 1.02 REFERENCE STANDARDS

- A. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position 2022.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- C. AWI (QCP) - Quality Certification Program Current Edition.
- D. ISFA 2-01 - Classification and Standards for Solid Surfacing Material 2013.
- E. NEMA LD 3 - High-Pressure Decorative Laminates 2005.
- F. PS 1 - Structural Plywood 2009 (Revised 2019).
- G. SEFA 2 - Installations 2010.
- H. SEFA 3 - Laboratory Work Surfaces 2010.

#### 1.03 SUBMITTALS

- A. See Section 013000 - 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. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.
- D. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.
- E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- G. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

#### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- B. Quality Certification:
  - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: [www.awiqcp.org/#sle](http://www.awiqcp.org/#sle).
  - 2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
  - 3. Provide designated labels on shop drawings as required by certification program.
  - 4. Provide designated labels on installed products as required by certification program.

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5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

### 1.06 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

## PART 2 PRODUCTS

### 2.01 COUNTERTOPS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Quality Standard: SEFA 3 for laboratory worksurfaces.
- C. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
  1. Laminate Sheet, Type [ ]: NEMA LD 3, Grade HGS, 0.048 inch nominal thickness.
    - a. Manufacturers:
      - 1) Panolam Industries International, Inc; Pionite Standard HPL: [www.panolam.com/#sle](http://www.panolam.com/#sle).
      - 2) Wilsonart: [www.wilsonart.com/#sle](http://www.wilsonart.com/#sle).
    - b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
    - c. Wear Resistance: In addition to specified grade, comply with NEMA LD 3 High Wear Grade requirements for wear resistance.
    - d. Finish: Matte or suede, gloss rating of 5 to 20.
    - e. Surface Color and Pattern: As indicated on drawings.
  2. Exposed Edge Treatment: Square, substrate built up to minimum 1-1/4 inch thick; covered with matching laminate.
  3. Back and End Splashes: Same material, same construction.
  4. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Custom Grade.
  5. Fabricate in accordance with manufacturer's standard requirements.
- D. Epoxy Resin Countertops: Filled epoxy resin molded into homogenous, non-porous sheets; no surface coating and color and pattern consistent throughout thickness; with integral or adhesively seamed components.
  1. Manufacturers:
    - a. Durcon, Inc: [www.durcon.com/#sle](http://www.durcon.com/#sle).
    - b. Prime Industries, Inc: [www.piilab.com/#sle](http://www.piilab.com/#sle).
  2. Flat Surface Thickness: 1 inch, nominal.
  3. Chemical-Resistance: Provide products that resist the following chemicals with not more than Moderate Effect when tested in accordance with NEMA LD 3:
  4. Flammability: Self-extinguishing, when tested in accordance with ASTM D635.
  5. Surface Finish: Smooth, non-glare.
  6. Color: Black.
  7. Exposed Edge Shape: 1/8 inch bevel chamfer.
  8. Drip Edge: Drip groove 1/8 inch wide and deep, located 1/2 inch back from edge on underside of all exposed edges.
  9. Back and End Splashes: Same material, same thickness; separate for field attachment.

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10. Sinks: Same material, same color; integrally molded with counter; bottom sloped to outlet; molded outlets; drain outlet located in back corner.
    - a. Sides and Ends: 1/2 inch minimum thickness.
    - b. Bottoms: 5/8 inch minimum thickness.
    - c. Interior Corners: 1 inch minimum radius.
    - d. Clamping collars for 1-1/2 or 2 inch diameter waste pipe, for sealed but not permanent connection.
    - e. Steel channel supports front to back on each side, fastened to underside of top to support twice full sink weight.
  11. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.
  12. Fabricate in accordance with manufacturer's standard requirements.
- E. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
1. Flat Sheet Thickness: 1/4 inch, minimum.
  2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
    - a. Manufacturers:
      - 1) Arsitech.
    - b. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
    - c. Color and Pattern: As indicated on drawings.
  3. Other Components Thickness: 1/2 inch, minimum.
  4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
  5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
  6. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.
  7. Fabricate in accordance with manufacturer's standard requirements.
- F. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
1. Flat Sheet Thickness: 1-1/4 inch, minimum.
  2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
    - a. Manufacturers:
      - 1) Caesarstone.
    - b. Finish on Exposed Surfaces: Polished.
    - c. Color and Pattern: As indicated on drawings.
  3. Other Components Thickness: 3/4 inch, minimum.
  4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
  5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
  6. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.
  7. Fabricate in accordance with manufacturer's standard requirements.

## 2.02 MATERIALS

- A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.

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- B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- C. Joint Sealant: Mildew-resistant silicone sealant, white.

### **2.03 FABRICATION**

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
  - 1. Join lengths of tops using best method recommended by manufacturer.
  - 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
    - a. Rout a 1/8 inch drip groove at underside of exposed overlapping edges, set back 1/2 inch from face of edge.
  - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
  - 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
  - 2. Height: 4 inches, unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

### **3.02 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### **3.03 INSTALLATION**

- A. Install laboratory worksurface countertops in compliance with requirements of SEFA 2.
- B. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- C. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.
- D. Attach epoxy resin countertops using compatible adhesive.
- E. Seal joint between back/end splashes and vertical surfaces.

### **3.04 TOLERANCES**

- A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
- B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
- C. Field Joints: 1/8 inch wide, maximum.

### **3.05 CLEANING**

- A. Clean countertop surfaces thoroughly.

### **3.06 PROTECTION**



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- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

**END OF SECTION**

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**SECTION 220130  
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. Demolition.
  - 10. Equipment installation requirements common to equipment sections.
  - 11. Concrete bases.
  - 12. 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, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- D. 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 Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 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.
- B. 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**

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- 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. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

#### **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 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.

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- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psi minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psi 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. 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. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

## 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. One-Piece, Floor-Plate Type: Cast-iron floor plate.

## 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.

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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. Sleeves are not required for core-drilled holes.
- B. 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.
- 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. 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

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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.
- E. 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.
- F. Verify final equipment locations for roughing-in.
- G. 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. 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.
- F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 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.
  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.

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### 3.07 PAINTING

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

### 3.08 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.

### 3.09 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.

### 3.10 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.
  - 6. Place grout around anchors.
  - 7. Cure placed grout.

### 3.11 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- C. Owner shall have first right-of refusal for salvage of all items to be removed. All items accepted for salvage by the Owner shall be protected from damage and delivered to the Owner's Representative. All items refused for salvage by the Owner shall be properly disposed of by

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the Contractor.

- D. For piping to remain, Contractor shall submit samples of existing piping to remain from locations as determined by the Engineer. Based on the results of destructive testing replacement of piping may be considered.
- E. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

**END OF SECTION 230130**



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**SECTION 220523  
GENERAL-DUTY VALVES FOR PLUMBING PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Applications.
- B. General requirements.
- C. Ball valves.
- D. Check valves.
- E. Plug valves.

**1.02 RELATED REQUIREMENTS**

- A. Section 220553 - Identification for Plumbing Piping and Equipment.
- B. Section 220719 - Plumbing Piping Insulation.
- C. Section 221005 - 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. PTFE: Polytetrafluoroethylene.

**1.04 REFERENCE STANDARDS**

- A. API STD 594 - Check Valves: Flanged, Lug, Wafer, and Butt-Welding 2022.
- B. ASME B1.20.1 - Pipe Threads, General Purpose, Inch 2013 (Reaffirmed 2018).
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.
- D. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard 2020.
- E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves 2022.
- F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.
- G. ASME B16.34 - Valves — Flanged, Threaded, and Welding End 2020.
- H. ASME B31.9 - Building Services Piping 2020.
- 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 2021.
- J. ASTM A48/A48M - Standard Specification for Gray Iron Castings 2022.
- K. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings 2004 (Reapproved 2019).
- L. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures 1999 (Reapproved 2022).
- M. ASTM A536 - Standard Specification for Ductile Iron Castings 1984, with Editorial Revision (2019).
- N. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings 2015 (Reapproved 2021).
- O. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings 2017.
- P. AWWA C606 - Grooved and Shouldered Joints 2015.

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- Q. MSS SP-45 - Drain and Bypass Connections 2020.
- R. MSS SP-67 - Butterfly Valves 2022.
- S. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends 2011.
- T. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends 2018.
- U. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service 2010a.
- V. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends 2011.
- W. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves 2019.
- X. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends 2011.
- Y. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010, with Errata .
- Z. MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided 2018.
- AA. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.
- BB. NSF 372 - Drinking Water System Components - Lead Content 2022.

#### **1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
- E. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
  - 1. See Section 016000 - Product Requirements, for additional provisions.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer:
  - 1. Obtain valves for each valve type from single manufacturer.
  - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

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

- A. Prepare valves for shipping as follows:
  - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
  - 2. Protect valve parts exposed to piped medium against rust and corrosion.
  - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
  - 4. Secure check valves in either the closed position or open position.
  - 5. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection and protect flanges and specialties from dirt.
    - a. Provide temporary inlet and outlet caps.
    - b. Maintain caps in place until installation.
  - 2. Store valves in shipping containers and maintain in place until installation.
    - a. Store valves indoors in dry environment.
    - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

#### **1.08 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:**

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- 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 MANUFACTURERS**

- A. Unless otherwise indicated, general duty valves shall be provided from one of the following manufacturers:
  1. Apollo Valves: [www.apollovalves.com](http://www.apollovalves.com)
  2. Ferguson Enterprises Inc: [www.fnw.com](http://www.fnw.com)
  3. NIBCO: [www.nibco.com](http://www.nibco.com)
  4. Substitutions: See Section 016000 - Product Requirements.

### **2.02 APPLICATIONS**

- A. See drawings for specific valve locations.
- B. Provide the following valves for the applications if not indicated on drawings:
  1. Shutoff: Ball, plug.
  2. Throttling: Provide ball.
- 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.

### **2.03 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. Hand Lever: Quarter-turn valves 6 NPS and smaller.
  2. 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.
- E. Valve-End Connections:
  1. Threaded End Valves: ASME B1.20.1.
  2. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
  3. 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.

### **2.04 BRASS BALL VALVES**

- A. Two Piece, Full Port and Regular Port with Brass Trim:
  1. Comply with MSS SP-110.

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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.

## **2.05 BRONZE BALL VALVES**

- A. 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.
  7. Stem: Bronze.
  8. Ball: Chrome plated brass.

## **2.06 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.

## **2.07 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:

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1. Swing Check: Install horizontal maintaining hinge pin level.

**END OF SECTION**

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**SECTION 220529  
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 RELATED REQUIREMENTS**

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

**1.02 REFERENCE STANDARDS**

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping 2022.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999, with Editorial Revision (2022).
- F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.
- G. MFMA-4 - Metal Framing Standards Publication 2004.
- H. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).

**1.03 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 033000.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. 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.

**1.05 QUALITY ASSURANCE**

- A. Comply with applicable building code.

**PART 2 PRODUCTS**

**2.01 SUPPORT AND ATTACHMENT COMPONENTS**

- A. General Requirements:

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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. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    - b. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
- 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.
- C. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
    - a. Piping up to 1 inch (27 mm) nominal: 1/4 inch diameter.
    - b. Piping larger than 1 inch (27 mm) nominal: 3/8 inch diameter.
    - c. Trapeze Support for Multiple Pipes: 3/8 inch diameter.
- D. 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.
- E. 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.
- F. Strut Clamps: Two-piece pipe clamp.
- G. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.
- H. 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.
- I. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
1. Pipe Diameter 6 inches and Smaller: Provide minimum clearance of 0.16 inch.
- J. Pipe Alignment Guides: Galvanized steel.

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1. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
- K. 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. Simpson Strong-Tie Company Inc; [\_\_\_\_\_]: [www.strongtie.com/#sle](http://www.strongtie.com/#sle).
  2. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
  3. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
  4. Sheet Metal: Use sheet metal screws.
  5. Wood: Use wood screws.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

#### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- F. 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 4 inch high concrete pad constructed in accordance with Section 033000.
  5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- G. Secure fasteners according to manufacturer's recommended torque settings.
- H. 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**

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**SECTION 220553  
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. Warning tags.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each type of product indicated.
- C. Samples: For color, letter style, and graphic representation required for each identification material and device.
- D. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- E. Valve numbering scheme.
- F. Valve Schedule: For each piping system to include in maintenance manuals.

**1.04 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:
  - 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).

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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.
  2. Fasteners: Brass 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.

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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. Control Panels: Nameplates.
- B. Piping: Tags.
- C. Pumps: Nameplates.
- D. Valves: Tags [\_\_\_\_\_].

## 2.07 NAMEPLATES

- A. 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. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

## 2.09 PIPE MARKERS

- A. Comply with ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

## 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.

### 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

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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 similiar rough-in connections on end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similiar 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.

**END OF SECTION**

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**SECTION 220716  
PLUMBING EQUIPMENT INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Equipment insulation.
- B. Covering.

**1.02 RELATED REQUIREMENTS**

- A. Section 221005 - Plumbing Piping: Placement of hangers and hanger inserts.

**1.03 REFERENCE STANDARDS**

- A. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement 2007 (Reapproved 2019).
- B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2020a.
- C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).
- D. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type) 2022a.
- E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022.
- H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

**1.06 FIELD CONDITIONS**

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

**PART 2 PRODUCTS**

**2.01 REGULATORY REQUIREMENTS**

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, ASTM E84, or UL 723.

**2.02 GLASS FIBER, FLEXIBLE**

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- A. Manufacturers:
  1. Owens Corning Corp; [\_\_\_\_\_]: [www.owenscorning.com/#sle](http://www.owenscorning.com/#sle).
  2. Substitutions: See Section 016000 - Product Requirements.
- B. Insulation: ASTM C553; flexible, noncombustible.
  1. 'K' Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
  2. Maximum Service Temperature: 450 degrees F.
  3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
  1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
  2. Secure with self-sealing longitudinal laps and butt strips.
- D. Vapor Barrier Lap Adhesive: Compatible with insulation.
- E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

### 2.03 GLASS FIBER, RIGID

- A. Manufacturer:
  1. CertainTeed Corporation; [\_\_\_\_\_]: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
  2. Johns Manville Corporation; [\_\_\_\_\_]: [www.jm.com/#sle](http://www.jm.com/#sle).
  3. Owens Corning Corp: [www.owenscorning.com/#sle](http://www.owenscorning.com/#sle).
  4. Substitutions: See Section 016000 - Product Requirements.
- B. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
  1. 'K' Value: 0.25 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
  2. Maximum Service Temperature: 850 degrees F.
  3. Maximum Water Vapor Absorption: 5.0 percent by weight.
  4. Maximum Density: 8.0 lb/cu ft.
- C. Vapor Barrier Jacket:
  1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
  2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
  3. Secure with self-sealing longitudinal laps and butt strips.
- D. Vapor Barrier Lap Adhesive: Compatible with insulation.
- E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

### 2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
  1. Aeroflex USA, Inc: [www.aeroflexusa.com/#sle](http://www.aeroflexusa.com/#sle).
  2. Armacell LLC; AP Armaflex: [www.armacell.us/#sle](http://www.armacell.us/#sle).
  3. K-Flex USA LLC: [www.kflexusa.com/#sle](http://www.kflexusa.com/#sle).
  4. Substitutions: See Section 016000 - Product Requirements.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3, in sheet form.
  1. Minimum Service Temperature: Minus 40 degrees F.
  2. Maximum Service Temperature: 220 degrees F.
  3. Connection: Waterproof vapor barrier adhesive.

### 2.05 JACKETS

- A. PVC Plastic:
  1. Jacket: Sheet material, off-white color.

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- a. Minimum Service Temperature: Minus 40 degrees F.
- b. Maximum Service Temperature: 150 degrees F.
- c. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
- d. Thickness: 10 mil.
- e. Connections: Brush on welding adhesive.
- 2. Covering Adhesive Mastic: Compatible with insulation.
- B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that equipment has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

**3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Factory Insulated Equipment: Do not insulate.
- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- F. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- G. For fiberglass insulated equipment containing fluids below ambient temperature, provide vapor barrier jackets, factory-applied or field-applied, and finish with glass cloth and vapor barrier adhesive.
- H. For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
- I. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.
- J. Fiberglass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
- K. Inserts and Shields:
  - 1. Application: Equipment 1-1/2 inches diameter or larger.
  - 2. Shields: Galvanized steel between hangers and inserts.
  - 3. Insert location: Between support shield and equipment 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.
- L. Finish insulation at supports, protrusions, and interruptions.
- M. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
- N. Exterior Applications:
  - 1. Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement.
  - 2. Cover with aluminum, stainless steel, or [\_\_\_\_\_].
- O. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.

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- P. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- Q. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

**3.03 SCHEDULES**

- A. Plumbing Systems:
  - 1. Domestic Hot Water Storage Tanks:
    - a. Glass Fiber, Flexible Insulation: [ ] inches thick.

**END OF SECTION**



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**SECTION 220719  
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 221005 - 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 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019.
- D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2020a.
- E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2022a.
- F. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2018).
- G. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber 2020.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022.
- J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

**1.05 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Qualification Data: For qualified installer.
- C. 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.
- D. Field quality-control reports.

**1.06 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

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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.

#### **1.07 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.

#### **1.08 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.

#### **1.09 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.

#### **1.10 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:
    - 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. Johns Manville; Micro-Lok.
    - b. Knauf Insulation; 1000 Pipe Insulation.

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- c. 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 GLASS FIBER

- A. Manufacturers:
  - 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; Fiberglass Pipe Insulation ASJ: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
  - 5. Substitutions: See Section 016000 - 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.

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- 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.

**2.05 FLEXIBLE ELASTOMERIC CELLULAR INSULATION**

- A. 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.

**2.06 JACKETS**

- A. 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.
- B. 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.
  - 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:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature range between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- 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**

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- 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.
  - 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:

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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 thightly 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 applicaitons 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.
  3. General pipe insulation installation.
- G. Requirements in this artical 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. Insulated pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be 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.

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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 gauges, 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.
    3. Construct removable valve insulation 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

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- 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.
  - 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 performed sections fo 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:



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1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When performed 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 fo threaded strainers, tow 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 that 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.
  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 Waer below 60 Deg F (16 deg C):
  1. All Pipe Sizes: Insulation shall be one of the following:

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- 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. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- G. Glass fiber insulated pipes conveying fluids above ambient temperature:
  - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
  - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- H. Inserts and Shields:
  - 1. Application: Piping 1-1/2 inches diameter or larger.
  - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
  - 3. Insert Location: Between support shield and piping and under the finish jacket.
  - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 078400.
- J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with aluminum jacket.
- K. 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**

**SECTION 221005  
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. Flanges, unions, and couplings.
  - 5. Pipe hangers and supports.
  - 6. Valves.
  - 7. Flow controls.
  - 8. Check.
  - 9. Relief valves.
  - 10. Indirect and Condensate

**1.02 REFERENCE STANDARDS**

- A. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems 2015 (Reaffirmed 2020).
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2021.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2021.
- E. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes 2018.
- F. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV 2017.
- G. ASME B31.9 - Building Services Piping 2020.
- H. 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 2021.
- I. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.
- J. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings 2021.
- K. ASTM B32 - Standard Specification for Solder Metal 2020.
- L. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV) 2020.
- M. ASTM D2321- Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- N. AWWA C651 - Disinfecting Water Mains 2014, with Addendum (2020).
- O. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 2021.
- P. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications 2020.
- Q. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements 2015.
- R. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements 2015.
- S. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements 2015.
- T. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).

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- U. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.
- V. NSF 372 - Drinking Water System Components - Lead Content 2022.

### 1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- 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.

### 1.04 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.

### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

## 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.

### 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.

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- 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.

#### **2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING**

- A. 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.

#### **2.06 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.

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- 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.

## 2.07 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

## 2.08 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.

## 2.09 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.

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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.
  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.

## 2.10 RELIEF VALVES

- A. Pressure:
1. ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.
- B. Temperature and Pressure:
1. 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.

## 2.11 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.

## 2.12 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. 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.

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- 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. Install bell and spigot pipe with bell end upstream.
- O. Install valves with stems upright or horizontal, not inverted. Refer to Section 220523.
- P. Install water piping to ASME B31.9.
- Q. Sleeve pipes passing through partitions, walls and floors.
- R. 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.
- S. 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 220548.
  11. Support cast iron drainage piping at every joint.

### 3.05 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- D. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install ball valves for throttling, bypass, or manual flow control services.
- F. Provide lug end valves adjacent to equipment when provided to isolate equipment.
- G. Provide spring loaded check valves on discharge of water pumps.
- H. 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.

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- 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.

### 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:
      - 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**

**SECTION 221006  
PLUMBING PIPING SPECIALTIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Refrigerator valve and recessed box.
- E. Backflow preventers.
- F. Water hammer arrestors.
- G. Mixing valves.

**1.02 RELATED REQUIREMENTS**

- A. Section 221005 - Plumbing Piping.
- B. Section 224000 - Plumbing Fixtures.

**1.03 REFERENCE STANDARDS**

- A. ASME A112.6.3 - Floor and Trench Drains 2019.
- B. ASME A112.6.4 - Roof, Deck, and Balcony Drains 2003 (Reaffirmed 2012).
- C. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers 2017.
- D. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies 2021.
- E. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.
- F. NSF 372 - Drinking Water System Components - Lead Content 2022.
- G. PDI-WH 201 - Water Hammer Arresters 2017.
- H. NSF 61, "Drinking Water System Components."
- I. California Health & Safety Code 116875 for lead free content.

**1.04 SUBMITTALS**

- A. See Section 013000 - 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**

**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:

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1. Jay R. Smith Manufacturing Company: [www.jayrsmith.com/#sle](http://www.jayrsmith.com/#sle).
2. Josam Company: [www.josam.com/#sle](http://www.josam.com/#sle).
3. Zurn Industries, LLC: [www.zurn.com/#sle](http://www.zurn.com/#sle).

B. 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.

C. Floor Drain (FD-2):

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 round nickel bronze strainer with removable perforated sediment bucket.

D. Floor Sink:

1. Lacquered cast iron body with dome strainer and seepage flange.

## 2.03 CLEANOUTS

A. Exposed Metal Cleanouts :

1. Standard: ASME A112.3.1 for stainless steel for cleanout test tee.
2. Size: Same as connected drainage piping
3. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk, brass plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts :

1. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron ferrule cleanout.
2. Size: Same as connected branch.
3. Type: Cast-iron soil pipe with cast-iron ferrule.
4. Body or Ferrule:
5. Clamping Device: Required.
6. Outlet Connection: Inside calk.
7. Closure: Brass plug with tapered threads.
8. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Material and Finish: Stainless steel.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Heavy Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
13. Standard: ASME A112.3.1.
14. Size: Same as connected branch.
15. Housing: Stainless steel.
16. Closure: Stainless steel with seal.
17. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts :

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk, brass plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

## 2.04 ROOF FLASHING ASSEMBLIES

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- 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.
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. 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.

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- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic

## 2.09 HOSE BIBBS

- A. 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 REFRIGERATOR VALVE AND RECESSED BOX

- A. Description: Plastic preformed rough-in box with brass valves with wheel handle, slip in finishing cover.

## 2.11 BACKFLOW PREVENTERS

- A. 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 WATER HAMMER ARRESTORS

- A. 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.

## 2.13 MIXING VALVES

- A. Thermostatic Mixing Valves:
  - 1. Valve: Chrome plated cast brass or glass-filled polysulfonebody, stainless steel or copper alloy bellows or thermoplastic polymer cartridge, with integral temperature adjustment.
  - 2. 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.
  - 3. Accessories:
    - a. Check valve on inlets.
    - b. Volume control shut-off valve on outlet.
    - c. Strainer stop checks on inlets.
  - 4. 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; janitor rooms, fire sprinkler systems, flush valves, interior and exterior hose bibbs.

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- F. Pipe relief from backflow preventer to nearest drain.
- G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories and sinks .

**END OF SECTION**

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**SECTION 230500  
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, crawlspaces, 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 & accessoires 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.
  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

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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.
  - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

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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**

**SECTION 230517  
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) 2022a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).

**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.

**PART 2 PRODUCTS**

**2.01 PIPE SLEEVES**

- A. **Vertical & Horizontal Piping:**
  - 1. Sleeve Length: 1 inch beyond **structural wall or floor assembly**.
  - 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.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Provide sleeves when penetrating **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. Aboveground Piping:
    - a. Pack solid using mineral fiber in compliance with ASTM C592.
    - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
  - 2. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
  - 3. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- E. 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**

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**SECTION 230529  
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**

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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**

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**SECTION 230548  
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 Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings 2016.
- C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications Most Recent Edition Cited by Referring Code or Reference Standard.
- D. MFMA-4 - Metal Framing Standards Publication 2004.
- E. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172 2019.
- F. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems 2008.

**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:

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- 1) Include base weights, including concrete fill where applicable; indicate equipment mounting provisions, attachments to isolators and supported equipment.
- 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.

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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**

- 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.

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- 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.
  - 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.

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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):
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.

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1. Refer to Drawings.

**END OF SECTION**



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**SECTION 230553  
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 016000 - 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.
- 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

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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.

## PART 3 EXECUTION

### 3.01 PREPARATION

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- 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**

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**SECTION 230593  
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 2016.
- B. AABC MN-1 - AABC National Standards for Total System Balance 2002.
- C. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems 2008, with Errata (2019).
- D. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems 2015, with Errata (2017).
- E. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing 2002.

**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 to the Commissioning Authority.
  - 2. Submit six weeks prior to starting the testing, adjusting, and balancing work.
  - 3. 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.
  - 4. 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. **Coordinate support required of EMS Controls contractor prior to start of TAB activities**
- D. 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.
- E. **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).

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- c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: [www.tabbcertified.org/#sle](http://www.tabbcertified.org/#sle).
- 4. Testing agency must also be certified by **Acceptance Testing Technician ATT** program available by California Energy Commission CEC.
  - a. ATT will test all mechanical systems per NRCC-MCH-E Forms
  - b. The acceptance testing procedures must be repeated and deficiencies must be corrected by the builder or installing contractor until the construction/installation of the specified systems conform and pass the required acceptance criteria.
  - c. More information regarding CEC ATT can be found here <https://www.energy.ca.gov/programs-and-topics/programs/acceptance-test-technician-certification-provider-program/acceptance>

### 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.

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- 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.
- 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.

### 3.07 COMMISSIONING

- A. Commissioning field shall only begin once all equipment startup and TAB activities are complete.
- B. **See Sections 230800 Commissioning of HVAC Systems** & specifically Section 3.03 for additional requirements and supporting activities required of Testing & Balancing Contractor.
- C. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.
- D. **Re-check outdoor air intake (min and max airflows) and a random sample equivalent to 20% percent of the final TAB report data as directed by Commissioning Authority.**

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1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
  2. Use the same test instruments as used in the original TAB work.
  3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
  4. For purposes of re-check, failure is defined as follows:
    - a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
    - b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
    - c. Temperatures: Deviation of more than one degree F.
    - d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
    - e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
  5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
- E. In the presence of the Commissioning Authority, verify that:
1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
  2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
  3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

**END OF SECTION**



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**SECTION 230713  
DUCT INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. INDOOR - Duct insulation
- B. OUTDOOR - JACKETS
- C. INDOOR & OUTDOOR - Duct liner

**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**

- A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.

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- 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.
- D. Insulated ducts conveying air above ambient temperature:
  - 1. Provide with or without standard vapor barrier jacket.

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- 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**

**SECTION 230719  
HVAC PIPING INSULATION**

**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 078400.
- 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**

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**SECTION 230923  
DIGITAL CONTROL SYSTEM FOR HVAC**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. The Direct-Digital Control (DDC) System specified herein shall include materials, operator workstation, building controllers, sensors, control valves, wiring, installation, start-up, testing, documentation and training for a complete operable system as required for this project.
- B. Controls Engineering shall be provided by the local controls manufacturer representative.
- C. Work specified under this section shall be performed by, or under the direct supervision of the local controls manufacturer representative, or by a contractor that is certified by the controls manufacture to perform all work within Section 23 09 00 Instrumentation and Control for HVAC and those sections of 23 09 00 that have been specified herein.
- D. Alternate techniques, modifications or changes to any aspect of these specifications may be submitted as a voluntary alternate no later than (15) days prior to the bid date and with sufficient information for a complete evaluation. This information shall include product data sheets, a UL508A Standard for Industrial Control Panels statement of compliance for any locally manufactured control panels, a detailed sequence of operation and engineered shop drawing. Shop drawings shall include the following as a minimum. Point to point wiring diagrams for each piece of equipment to be controlled, a network riser diagram that will depict quantity and location of the operator workstation, controllers, routers and repeaters required for this project.

**1.02 RELATED SECTIONS**

- A. General Requirements
- B. Submittal Procedures
- C. 23 00 00: Heating, Ventilating, and Air Conditioning (HVAC)

**1.03 SUBMITTALS**

- A. Submit engineered shop drawings, sequences of operation, third party equipment and controls integration points and product data sheets covering all items of equipment for the proposed system prior to installation for approval. Any deviation from the contract documents shall be noted and the drawings signed and dated by the Contractor. Additionally, submit a UL508A Standard for Industrial Control Panels statement of compliance for any locally manufactured control panels.
- B. After completion of the installation and commissioning, a full set of as-built documentation shall be turned over to the Owner. The as-built shall include operation and maintenance manuals, sequence of operation, shop drawings and digital copies of the following.
  - 1. Complete DDC System database backup
  - 2. Source files for all custom written controller applications
  - 3. Source files for graphics if required for this project

**1.04 WARRANTY**

- A. Components, system software, and parts shall be guaranteed against defects in materials, fabrication, and execution for (1) year from date of system acceptance. Provide labor and materials to repair, reprogram, or replace components at no charge to the Owner during the warranty period.
- B. Provide a list of applicable warranties for components, this list shall include warranty information, names, addresses, telephone numbers, and procedures for filing a claim and obtaining warranty services.
- C. Respond to the Owner's request for warranty service within (24) hours during normal business hours. Submit records of the nature of the call, the work performed, and the parts replaced or service rendered.

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- D. Contractor shall request VPN access from owner and provide remote maintenance, software updates and repair service for the duration of the warranty period.

### 1.05 TRAINING

- A. Provide a competent instructor who is factory trained and has comprehensive knowledge of system components and operations to provide full instructions to designated personnel in the system operation, maintenance, and programming. Training shall be specifically oriented to installed equipment and systems.
- B. Provide (8) hours of onsite owner familiarization and training for the installed system. Training shall include system overview, time schedules, emergency operation, and programming and report generation.
- C. Owner employees attending this training session shall be provided with the following documentation:
  - 1. System layout point to point connection diagram.
  - 2. System components cut sheets.
  - 3. Operations and maintenance data.
- D. Provide classroom training for (2) owner technicians, classes to include Carrier CS Level and Carrier IS Level training with a total of (48) hours per student.

### 1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Do not store or install electronic hardware on the project until non-condensing environmental conditions have been established.

## PART 2 PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. DDC Equipment: Carrier OPEN BACnet Controls. No substitutions will be accepted.
- B. Controls installation will be by Carrier Controls Expert Dealer.
- C. The local manufacture representative will operate a free 40 hour a week, toll free customer support hotline for additional user support services that are required.

### 2.02 SYSTEM LISTING COMPLIANCE

- A. Locally manufactured control panels shall meet all requirements as outlined by UL 508A standard and shall be both approved and listed by Underwriters Laboratories, Inc.

### 2.03 COMMUNICATION

- A. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.
- B. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- C. Use owner provided Ethernet backbone for network segments.

### 2.04 OPERATOR INTERFACE

- A. Description. The control system shall be as shown and consist of a high-speed, peer-to-peer network of DDC controllers and a stand-alone web server operator interface. Depict each mechanical system and building floor plan by a point-and-click graphic. A web server shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators with sufficient access level shall have an ability to make changes to all system and equipment graphics in the web server in addition to having full DDC system access to make configuration changes to the control system. Any tools required for making graphic changes shall be provided with web server.
- B. Operator Interface. Furnish (1) Web server interface as shown on the system drawings.

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1. With the use of an owner provided remote SMTP email server the operators interface web server shall notify personnel of an alarm and record information about an alarm in the DDC system.
  2. Any required installation or commissioning software shall be provided to the owner.
- C. Operator Functions. Operator interface shall allow each authorized operator to execute the following functions as a minimum:
1. Log In and Log Out
  2. Point-and-click Navigation
  3. View and Adjust Equipment Properties
  4. View and Adjust Operating Schedules
  5. View and Respond to Alarms
  6. View and Configure Trends
  7. Manage Control System Hardware
  8. Manage Operator Access
- D. System Graphics. Operator interface shall be graphical and shall include at least one graphic per piece of equipment and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.
- E. Trend Configuration. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs.
- F. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Furnish the following standard system reports.
1. Alarm Reports
  2. Schedule Reports
  3. Security Reports
  4. Commissioning Reports
  5. Equipment Reports
- G. Energy Conservation
1. Outside Air Lockout. Lock out heating or cooling modes based on configurable outside air temperature limits.
  2. Demand Limiting
    - a. System shall monitor building power consumption from building power meter pulse generator signals or from building feeder line watt transducer or current transformer.
    - b. The system shall include all required hardware and software necessary to receive an Automated Demand Response (ADR) signal from the utilities Demand Response Automation Server (DRAS).
    - c. When power consumption exceeds adjustable levels, or the system receives an ADR signal from the utility, the system shall automatically adjust set points, and take other programmatic actions to reduce demand.
  3. Optimal Start. The system shall bring the conditioned space to within occupied set points prior to the occupied time period to ensure occupant comfort.
  4. Demand Controlled Ventilation (DCV). Each controlled space shall have a Carbon Dioxide (CO2) sensor and shall maintain a ventilation setpoint through a DCV algorithm to fulfill the requirements of ASHRAE standard, 62-1989 "Ventilation for Acceptable Indoor Air Quality" (including Addendum 62a-1990).

## 2.05 CONTROLLERS

- A. General. The control system shall be available as a complete package with the required input sensors and devices readily available. Provide BACnet Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), and Sensors (SEN) as required.



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- B. Stand-Alone Operation. Each piece of equipment shall be controlled by a single controller to provide stand-alone control in the event of communication failure.
- C. Serviceability. Controllers shall have diagnostic LEDs for power, communication, and processor.
- D. Rooftop Unit Controller (RTC). Defined as Application Specific Controllers (ASC), shall be factory installed by the HVAC manufacturer and shall control all associated HVAC rooftop equipment functions in a single zone application or as part of a zoning system application.
  - 1. Capacity control shall be based by the RTC internal time clock and setpoints (cooling and heating) coupled with a communicating room sensor. The controls shall provide separate occupied and unoccupied cooling and heating setpoints.
  - 2. RTC shall utilize up to 2 speed of fan control, up to 3 stages of cooling, and up to 4 stages of heating.
  - 3. RTC shall provide economizer control that has been certified for Fault Detection and Diagnostics (FDD) by California Energy Commission (CEC). The FDD system shall detect the following faults:
    - a. Air temperature sensor failure/fault
    - b. Not economizing when it should
    - c. Economizing when it should not
    - d. Damper not modulating
    - e. Excess outdoor air
- E. General Purpose Controller. Defined as Advanced Application Controller (AAC) shall be a solid state micro-controller with pre-tested and factory configured software designed for controlling building equipment using DDC algorithms and facility management routines. The controller shall be capable of operating in either a stand-alone mode or as part of a network.

## 2.06 FIELD INSTALLED SENSORS

- A. Space Temperature Sensors shall communicate to the controller over a 4-wire communication network and have setpoint adjustment, after hours override, occupancy sensor, LCD display and a communication service port.
- B. Carbon dioxide sensor (CO2) shall be integrated into the Space Temperature Sensors and have integral programming to perform automatic baseline calibration without user interface. The recommended manual recalibration period shall not be less than five years.
- C. Status indication for fans or pumps shall be provided by current sensing switch. The sensor shall be installed at the motor starter or motor to provide load indication. The unit shall consist of a current transformer, a solid state current sensing circuit (with adjustable set point) and a solid state switch. A light emitting diode (LED) shall indicate the on off status of the unit.

## 2.07 CONTROL PANELS

- A. Provide single-door, UL 508A Listed; NEMA Type 1, 3R or 4 to match environmental conditions, wall-mount enclosures for each system under automatic control. Mount relays, switches, and controllers in cabinet and indicators, pilot lights, push buttons and switches flush on enclosure exterior face as required.
- B. Fabricate panels from 16 gauge steel with ANSI 61 gray finish and shall include (1) black padlock handle that will accommodate a padlock with up to a 5/16-in. locking bar for secure access to the enclosure contents. All additional latches shall be black non-locking handle type.
- C. Provide engraved name plates that identify each control panel and for each component mounted to the exterior of the enclosure.
- D. Provide a complete wiring diagram, bill of material for all components and markings with the following information:
  - 1. Manufacturer's name or trademark
  - 2. Supply voltage, number of phases, frequency, and full-load current for each incoming supply circuit

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3. Enclosure type number

### **PART 3 EXECUTION**

#### **3.01 ELECTRICAL WIRING**

- A. This contractor is responsible for all low voltage electrical installation and wiring for a fully operational DDC System as shown on the drawings and shall perform electrical installation in accordance with local and national electrical codes and in accordance with Division 26.
- B. Electrical Contractor is responsible for providing power from local electrical panels to the DDC System control panels.

#### **3.02 ACCEPTANCE PROCEDURE**

- A. Upon completion of the installation, the contractor shall start-up the system and perform all necessary calibration and testing to ensure the proper operation of the DDC System.
- B. After all calibration and testing have been completed, the contractor shall schedule a hardware demonstration and system acceptance test to be performed in the presence of the designated owner's representatives.
- C. The contractor shall be a member of the designated Commissioning Team and shall be responsible for performing procedures presented in specification and contract drawings as detailed in the Functional Performance Tests (FPT).

**END OF SECTION**

**SECTION 232300  
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 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.
    - b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.

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- 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.

## 2.02 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.

## 2.03 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.

## 2.04 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.

## 2.05 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.

## 2.06 PRESSURE REGULATORS

- A. Brass body, stainless steel diaphragm, direct acting, adjustable over 0 to 80 psi range, for maximum working pressure of 450 psi.

## 2.07 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.

## 2.08 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.

## 2.09 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.

## 2.10 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.

## 2.11 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**

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## SECTION 233100 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 2015.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
- C. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations 2021.
- 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 2021.
- F. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual 2012.
- G. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors current edition, including all revisions.

#### 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**.



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- B. Ducts: Galvanized steel, unless otherwise indicated here within or on contract drawings.
- 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 per ASHRAE 90.1 Table 6-B.** 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. **Thermafex 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**

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**SECTION 233300  
AIR DUCT ACCESSORIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Backdraft dampers
- B. Combination fire and smoke dampers.
- C. Duct access doors.
- D. Duct test holes.
- E. Flexible duct connections.
- F. Manual volume control dampers
- G. Remote actuated electronic volume control dampers.

**1.02 REFERENCE STANDARDS**

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
- 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 2021.
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.
- E. UL 33 - Safety Heat Responsive Links for Fire-Protection Service Current Edition, Including All Revisions.
- F. UL 555 - Standard for Fire Dampers Current Edition, Including All Revisions.
- G. UL 555S - Standard for Smoke Dampers Current Edition, Including All Revisions.

**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 ACCESS DOORS

### A. Manufacturers:

1. Acudor Products Inc, a Division of Nelson Industrial Inc: [www.acudor.com/#sle](http://www.acudor.com/#sle).
2. Ductmate Industries, Inc, a DMI Company: [www.ductmate.com/#sle](http://www.ductmate.com/#sle).
3. Lloyd Industries, Inc: [www.firedamper.com/#sle](http://www.firedamper.com/#sle).
4. Nailor Industries, Inc: [www.nailor.com/#sle](http://www.nailor.com/#sle).

### B. Fabricate in accordance with SMACNA (DCS) and as indicated.

## 2.04 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.

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- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

## 2.05 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Flexible Duct Connections: Fabric crimped into metal edging strip.
  - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
    - a. Net Fabric Width: Approximately 2 inches wide.
  - 2. Metal: 3 inches wide, 24 gage, 0.0239 inch thick galvanized steel.
- C. Maximum Installed Length: 14 inch.

## 2.06 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.

## 2.07 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

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- 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.

### **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 233100 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**



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**SECTION 233423  
HVAC POWER VENTILATORS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Roof exhausters.
- B. Gravity Ventilators.
- C. Upblast roof exhausters.
- D. Laboratory and fume exhaust.

**1.02 REFERENCE STANDARDS**

- A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program 2015.
- B. AMCA 99 - Standards Handbook 2016.
- C. AMCA 204 - Balance Quality and Vibration Levels for Fans 2020.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating 2016.
- E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans 2014.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data 2014.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- H. UL 705 - Power Ventilators Current Edition, Including All Revisions.

**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: [www.greenheck.com](http://www.greenheck.com)
- B. Loren Cook Company: [www.lorencook.com](http://www.lorencook.com)
- C. Twin City Fan & Blower: [www.tcf.com](http://www.tcf.com)

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D. Substitutions: See Section 016000 - Product Requirements.

## 2.02 GRAVITY VENTILATORS

- 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 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.
  - 4. Positive electrical shutoff.
  - 5. Wired from fan motor to junction box installed within motor compartment.
- D. **Roof Curb: 8 inch high MINIMUM self-flashing of aluminum with continuously welded seams, factory installed nailer strip. Roof curbs shall be slope compensating as required per contract drawings.**
- E. Drain Trough: Allows for single-point drainage of water, grease, and other residues.
- F. Options/Accessories:

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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.

## **2.04 LABORATORY AND FUME EXHAUST**

- A. Belt 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.
    - 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.

## **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.

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- 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**

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**SECTION 233700  
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 Air Inlets 2006 (Reaffirmed 2021).
- B. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.
- C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.

**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 016000 - 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 ¼ 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**

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**SECTION 234000  
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 2017, with Addendum (2022).
- C. UL 900 - Standard for Air Filter Units Current Edition, Including All Revisions.

**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 016000 - 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**



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**SECTION 234100  
HVAC AIR DISTRIBUTION SYSTEM CLEANING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Cleaning of **HVAC EXISTING DUCTWORK, EQUIPMENT** and related components.

**1.02 DEFINITIONS**

- A. **HVAC System:** For purposes of this section, the surfaces to be cleaned include **ONLY INTERIOR EXISTING DUCTWORK & EXISTING AIR CONDITIONING UNIT** surfaces of the heating, air-conditioning and ventilation system from the point of connection of the new ductwork to where the air enters the system (outdoor air).
- B. **Cleaning shall include**
1. **interior ductwork surfaces - supply, return, outdoor air, transfer air.**
    - a. **Existing flexible ductwork shall NOT be cleaned.**
  2. **Inside of air distribution equipment including walls, insulation, coils, fans, condensate pan & drain piping;**
  3. **See NADCA ACR for more details.**

**1.03 REFERENCE STANDARDS**

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- B. NADCA ACR - The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC System 2021.
- C. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors current edition, including all revisions.
- D. UL 181A - Closure Systems for Use with Rigid Air Ducts Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. **Scope: Provide sketch highlighting area to be cleaned, to confirm extent of work.**
- B. **Qualifications:** Submit **certifications & license** of cleaning contractor for approval. Technicians must be **NADCA ASCE Certified** to clean mold and mildew.
- C. **Project Evaluation and Cleaning Plan - Before and after photo documentation.**
- D. **Material Safety Data Sheets (MSDS):** For all chemical products proposed to be used in the cleaning process; submit directly to Owner.
- E. **Project Closeout Report:** Include field quality control reports, evidence of satisfactory cleaning (Before & After Photo Documentation)
- F. **Recommendations** identifying systems or equipment needing further repair
  1. Equipment Insulation and/or wall repair
  2. Equipment Condensate Pain and/or pipe leaks
  3. Ductwork Insulation or Lining Repair

**1.05 QUALITY ASSURANCE**

- A. **Cleaning Contractor Qualifications:** Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
  1. Certified by one of the following:
    - a. NADCA, National Air Duct Cleaners Association: [www.nadca.com](http://www.nadca.com)
    - b. Nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.
  2. Having minimum of **FIVE years** documented experience.
  3. **Technicians must be NADCA ASCE Certified to clean mold and mildew**

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4. Acceptable Cleaning Contractors:
  - a. Western Indoor Environmental Services, Tony Rosario 323-240-0095
  - b. Penn Air
  - c. Mintie Corporation

## **PART 2 PRODUCTS**

### **2.01 TOOLS AND EQUIPMENT**

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

### **2.02 REPLACEMENT PRODUCTS**

- A. Fibrous Glass Insulation: Provide material complying with UL 181 equivalent to existing material in quality and thickness.

### **2.03 SURFACE TREATMENTS**

- A. Anti-Microbial Materials: EPA registered specifically for use on non-porous HVAC system surfaces and applied per manufacturer's instructions.
- B. Surface Coating for Fibrous Glass Materials: Water-based, zero VOC; flame spread index less than 25, smoke developed index less than 450, Class A, when tested in accordance with ASTM E84.

## **PART 3 EXECUTION**

### **3.01 PROJECT CONDITIONS**

- A. Comply with applicable federal, state, and local requirements.
- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Obtain Owner's approval of proposed temporary locations for large equipment.
- E. Designate a decontamination area and obtain Owner's approval.
- F. If unforeseen mold or other biological contamination is encountered, notify Architect immediately, identifying areas affected and extent and type of contamination.

### **3.02 EXAMINATION**

- A. Prior to the commencement of any cleaning work, prepare and submit to Architect a project evaluation and plan for this project, including considerations recommended in NADCA ACR. **Project evaluation & Cleaning Plan shall be coordinated and scheduled with all parties prior to start of work to ensure minimal impact to construction schedule.**
- B. Inspect the system as required to determine appropriate methods, tools, equipment, and protection.
- C. Start of cleaning work constitutes acceptance of existing conditions.
- D. When concealed spaces are later made accessible, examine and document interior conditions prior to beginning cleaning.

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- E. Document all instances of mold growth, rodent droppings, other biological hazards, and damaged system components.

### 3.03 PREPARATION

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning.
- D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
  - 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
  - 2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.
  - 3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

### 3.04 CLEANING

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Ducts: Mechanically clean all portions of ducts.
- D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove refrigeration coils from system to clean; report coils that are permanently impacted.
- G. Fibrous Glass Material: Use HEPA vacuuming equipment, under constant negative pressure, do not permit to get wet, and do not damage surfaces; replace material damaged by cleaning operations.
- H. Existing Damaged Fibrous Glass Material: Report to Architect all evidence of damage, deterioration, delaminating, friable material, mold or fungus growth, or moisture that cannot be remedied by cleaning or resurfacing with an acceptable insulation repair coating.
  - 1. Material with active fungal growth is considered unremediable.
  - 2. Remove unremediable material and clean underlying surfaces.
  - 3. Where surface damage can be repaired by applying a coating, do so at no extra cost to Owner.
  - 4. Replace unremediable material.
- I. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- J. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

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### 3.05 REPAIR

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.
- F. **Once cleaning and repair work complete including recommendations, SEAL ductwork and equipment with temporary covers on all openings to protect foreign debris from entering clean surfaces during construction until connection to final system ready.**

### 3.06 FIELD QUALITY CONTROL

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
- D. **Notify Architect when cleaned components are ready for inspection.**
- E. When directed, re-clean components until they pass.
- F. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

### 3.07 ANTI-MICROBIAL TREATMENT

- A. When directed, apply anti-microbial treatment to internal surfaces.
- B. Apply anti-microbial agent after removal of surface deposits and debris.
- C. Apply anti-microbial treatments and coatings in strict accordance with the manufacturer's written recommendations and EPA registration listing.
- D. Spray coatings directly onto interior ductwork surfaces; do not "fog" into air stream.

### 3.08 ADJUSTING

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.

### 3.09 WASTE MANAGEMENT

- A. Double-bag waste and debris in 6 mil, 0.006 inch thick polyethylene plastic bags.
- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

**END OF SECTION**

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**SECTION 237413  
PACKAGED OUTDOOR AIR-CONDITIONING UNITS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Packaged roof top unit.
- B. Unit controls.
- C. Maintenance service.

**1.02 REFERENCE STANDARDS**

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment 2023.
- B. AHRI 270 - Sound Performance Rating of Outdoor Unitary Equipment 2015, with Addendum.
- C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.

**1.03 PERFORMANCE REQUIREMENTS**

- A. Refer to **contract drawing schedules & details**.

**1.04 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 DRAWING:** 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. **VIBRATION ISOLATION CALCULATIONS:** Submit structural calculations for vibration isolation rails indicating compliance with the applicable building code for seismic controls and the vibration isolator manufacturer's requirements, as required.
- H. **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 8 for commissioning/startup that shall be placed within unit once installed & discarded after testing is complete & prior to owner acceptance.
    - b. Two (2) MERV 14 filters of each type and size, one set placed within unit and (1) extra set for owner storage.

**1.05 QUALITY ASSURANCE**

- A. Startup must be done by trained personnel experienced with rooftop equipment.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.

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- B. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters and remote controls are in place, bearings lubricated, and manufacturers' installation instructions have been followed.

### 1.07 WARRANTY

- A. **Contractor shall provide the following warranty:**
  1. One year (1) labor warranty & guarantee on entire HVAC system (ductwork, pipes, etc) including packaged RTU equipment
  2. One year (1) labor & parts warranty period shall commence when Owner occupies building with Certificate of Occupancy Date
  3. RTU manufacturer shall provide twelve (12) month parts only warranty for all components within unit.
  4. RTU 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 RTU 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. Carrier
- B. Trane
- C. York

### 2.02 MANUFACTURED UNITS

- A. General: Roof mounted packaged air handling units having direct expansion refrigeration cooling coils and indirect gas fired heating coils.
- B. Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, VFD with Bypass , heat exchanger and burner, 460/60/3 Electrical Connections , controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan.
- C. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.
- D. Each unit shall be completely factory assembled and shipped in one piece.
- E. Packaged units shall be shipped fully charged with Refrigerant R410A.
- F. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include final balancing of the supply fan assemblies, a refrigeration circuit run test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection.

### 2.03 GENERAL

- A. Configuration: Fabricate as detailed on Drawings
  1. Economizer section integral to all RTU units
  2. Filter section

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3. Cooling coil Section
4. Supply fan section
5. Access section
6. Discharge plenum
7. Condensing unit section

- B. Each unit shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet.
- C. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.

#### 2.04 FABRICATION

- A. Standard **double**-wall construction for all side wall access, doors and floor areas shall be provided with **20-gauge**, solid galvanized steel inner liners to protect insulation during service and maintenance.
- B. Unit cabinet shall be designed to operate at total static pressures up to 6.5 in wg.
- C. Insulation on ceiling and end panels shall be secured with adhesive and mechanical fasteners.
- D. Heavy gauge solid galvanized steel liners shall be provided throughout, allowing no exposed insulation within the air stream. All cabinet insulation, except floor panels, shall be a nominal **one inch thick, with minimum insulation R-Value R=13. Insulation shall be rigid polyurethane foam insulation. Exposed open foil face insulation will NOT be accepted.**
- E. Exterior surfaces shall be constructed of prepainted galvanized steel for aesthetics and long term durability. Paint finish to include a base primer with a high quality, polyester resin topcoat of a neutral beige color. **Exterior casing shall have 500 hour salt spray coating in accordance with ASTM-B117.**
- F. All service doors shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system that is operated by a single, flushmounted lockable handle.

#### 2.05 SUPPLY FAN

- A. Supply Fan: Airfoil centrifugal type, resiliently mounted with V-belt drive, adjustable variable pitch motor pulley, and rubber isolated hinge mounted high efficiency motor or direct drive as indicated. Isolate complete fan assembly. 220548
- B. General: All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment. All fan assemblies shall employ solid steel fan shafts. Heavy-duty pillow block type, self-aligning, grease lubricated ball bearings shall be used. Bearings shall be sized to provide an L-50 life at 200,000 hours. The entire fan assembly shall be isolated from the fan bulkhead and mounted on spring isolators with seismic restraints. pitch V-belt drives with matching belts shall be provided. V-belt drives shall be selected at the manufacturers standard service factor.
- C. Motors: Fan motors shall be heavy-duty 1800 rpm premium efficiency. Fan motors to have grease lubricated ball bearings. Motors shall be mounted on an adjustable base that provides for proper alignment and belt tension adjustment.
- D. **Supply Fan:**
  1. **Type: Direct Drive backward curved plenum with rubber isolated hinge mounted premium efficiency motor. Isolate complete fan assembly. Belt drive fans not acceptable.**
  2. **Control: Fans shall be controlled via internally mounted VFDs**
- E. Air Filters (final filters): 2 inch thick (MERV-8) disposable media pre-filters. 4 inch thick (MERV-14) disposable final filters. Refer to Section 234000.

#### 2.06 HEATING BURNER SECTION

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- A. Provide a natural gas indirect fired gas furnace, single stage with aluminized steel heat exchanger.

## 2.07 ELECTRICAL

- A. The receptacle shall be powered by a field supplied 115V source.
- B. Single non-fused **NEMA 4X Disconnect switch** shall be provided for connecting electrical power at the unit. Disconnect switches shall be mounted internal to the control panel and operated by an externally mounted handle. Externally mounted handle is designed to prohibit opening of the control panel door without the use of a service tool. Minimum SCCR rating of 10k AIC.

## 2.08 EVAPORATOR COIL

- A. Provide **copper tube aluminum fin** coil assembly with **stainless steel drain pan** and connection.
- B. **Factory installed UVC lights mounted after coil for irradiation/disinfection to certify ETL Listing.**
- C. Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.

## 2.09 COMPRESSOR

- A. Provide hermetic compressors, 3600 rpm maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gage ports, and filter drier.

## 2.10 CONDENSER COIL

- A. **Provide copper tube aluminum fin aluminum microchannel condenser coils with coil guards.**
- B. Condenser coil to include factory applied corrosion resisant eletrocoating.
  1. Coil will have a flexible epoxy polymer e-coat uniformly applied to all coil surface areas.
  2. Uniform dry film thickness from 0.6 – 1.2 mils on all surface areas including fin edges.
  3. Corrosion durability will be confirmed through testing to no less than **5,000 hr salt spray** resistance per ASTM B117.
  4. UV-resistant mastic topcoat will be applied for outdoor condenser coils to prevent degradation of epoxy e-coat film.
- C. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor. Premium efficiency TEAO motors.
- D. Provide refrigerant pressure switches to cycle condenser fans.

## 2.11 OUTDOOR AIR ECONOMIZER

- A. **Unit shall be provided with an outdoor air economizer as part of RTU manufacturer casing.** The 0 to 100% outside air economizer section shall include outdoor, return, and exhaust air dampers. Outdoor air shall enter from both sides of the economizer section through horizontal, louvered intake panels complete with rain lip and bird screen. The floor of the outdoor air intakes shall provide for water drainage.
- B. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be opposed sets of parallel blades, arranged vertically to converge the return air and outdoor air streams in multiple, circular mixing patterns. Damper blades shall be fully gasketed and side sealed. Damper leakage shall be less than 0.2% at 1.5 inches static pressure differential. Leakage rate to be tested in accordance with AMCA Standard 500. Damper blades shall be operated from multiple sets of linkages mounted on the leaving face of the dampers.
- C. A barometric exhaust damper shall be provided to exhaust air out of the back of the unit.



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## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that proper power supply is available.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Mount units on factory built roof mounting curb providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

### **3.03 SYSTEM STARTUP**

- A. **Prepare and start equipment for owner acceptance based on Manufacturer's O&M Startup Checklist & required setpoints on mechanical control drawings.**
- B. **Start-up to be performed by one of the following:**
  - 1. Manufacturer's Authorized Service Technician (As required per Base Warranty)
  - 2. Subcontractor Certified Personnel
- C. **Notify Architect and Owner seven days prior to start-up of each item.**
  - 1. Notification shall include list of personnel who will begin startup and list schedule of equipment to be tested.
- D. **Startup technicians to provide equipment startup test outline to Commissioning Agent (CA) prior to startup activity to confirm:**
  - 1. Desired Testing Points available as manufacturer option
  - 2. Field Installed Control Points
- E. 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 as per manufacturers recommended startup sequence.
- F. **Startup shall include at a minimum:**
  - 1. Leak Free Assembly (Air & Water)
  - 2. Defect Free (System performing to scheduled capacity)
  - 3. Proper Fan/impeller Rotation
  - 4. Proper Spring Isolation Mounting
- G. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer. Verify that wiring and support components for equipment are complete and tested.
- H. Execute start-up under supervision of applicable Contractor personnel and certified personell in accordance with manufacturers' instructions.
- I. When specified in individual specification sections require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- J. **Submit a written final testing report & Manufacturer's O&M Startup Checklist to architect for record.**

### **3.04 CLOSEOUT ACTIVITIES**

- A. See Section **01 7000 Close Out Requirements** for closeout procedures.
- B. See Section **01 7900 Demonstration & Training** for additional requirements.
- C. **Demonstrate operation to Owner's maintenance personnel.**
- D. **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.**

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### 3.05 MAINTENANCE

- A. Provide service and maintenance of packaged roof top units for one year from **Certificate of Building Occupancy date.**
- B. After each service call, submit copy of service call work order or report that includes description of work performed.

**END OF SECTION**

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**SECTION 238126  
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 2023.
- B. AHRI 270 - Sound Performance Rating of Outdoor Unitary Equipment 2015, with Addendum.
- C. AHRI 520 - Performance Rating of Positive Displacement Condensing Units 2004.
- D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems 2019, with All Amendments and Errata.
- E. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant 2019.
- F. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size 2017, with Addendum (2022).
- G. NEMA MG 1 - Motors and Generators 2021.
- H. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
- I. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2021.
- J. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical Current Edition, Including All Revisions.

**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.

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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.
  - 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. Carrier Toshiba
- C. Mitsubishi | Trane
- D. 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

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1. **Disconnect Switch: Factory mount NEMA 4X Disconnect and as per provisions of Section 260533.13**

### **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.
  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.

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- 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.
  - 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.**

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### **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**

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**SECTION 238129  
VARIABLE REFRIGERANT FLOW HVAC SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Variable refrigerant volume HVAC system includes:
  1. Indoor/evaporator units.
  2. Refrigerant piping.
  3. Control panels.
  4. Control wiring.

**1.02 REFERENCE STANDARDS**

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment 2023.
- B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
- C. ITS (DIR) - Directory of Listed Products Current Edition.
- D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 1995 - Heating and Cooling Equipment Current Edition, Including All Revisions.

**1.03 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.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's standard data sheets showing the following for each item of equipment, marked to correlate to equipment item markings indicated in the Contract Documents:
  - 1. Operating and Maintenance Data:
    1. Manufacturer's complete standard instructions for each unit of equipment and control panel.
    2. Custom-prepared system operation, troubleshooting, and maintenance instructions and recommendations.
    3. Identification of replaceable parts and local source of supply.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
  1. Company that has been manufacturing variable refrigerant volume heat pump equipment for at least 5 years.
- B. Installer Qualifications: Trained and approved by manufacturer of equipment.

**1.06 DELIVERY, STORAGE AND HANDLING**

- A. Deliver, store, and handle equipment and refrigerant piping according to manufacturer's recommendations.

**1.07 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Basis of Design: The system design shown in the contract documents is based on equipment and system designed as indicated on Drawings.



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- B. Manufacturers:
  1. Carrier - Toshiba

## 2.02 HVAC SYSTEM DESIGN

- A. System Operation: Heating and cooling, simultaneously.
  1. Provide a complete functional system that achieves the specified performance based on the specified design conditions and that is designed and constructed according to the equipment manufacturer's requirements.
  2. Conditioned spaces are indicated on drawings.
  3. Outdoor/Condenser unit locations are indicated on drawings.
  4. Indoor/Evaporator unit locations are indicated on drawings.
  5. Refrigerant piping sizes are not indicated on drawings.
  6. Connect equipment to condensate piping provided by others; condensate piping is indicated on drawings.
- B. Refrigerant Piping Lengths: Provide equipment capable of serving system with following piping lengths without any oil traps:
  1. Minimum Piping Length from Outdoor/Central Unit(s) to Furthest Terminal Unit: 540 feet, actual; 620 feet, equivalent.
  2. Total Combined Liquid Line Length: 3280 feet, minimum.
  3. Minimum Piping Length Between Indoor Units: 49 feet.
- C. Control Wiring Lengths:
  1. Between Outdoor/Condenser Unit and Indoor/Evaporator Unit: 6,665 feet, minimum.
  2. Between Outdoor/Condenser Unit and Central Controller: 3,330 feet, minimum.
  3. Between Indoor/Evaporator Unit and Remote Controller: 1,665 feet.
- D. Controls: Provide the following control interfaces:
  1. For Each Indoor/Evaporator Unit: One wall-mounted wired "local" controller, with temperature sensor; locate where indicated.
  2. BACNet gateways sufficient to connect all units to building automation system by others; include wiring to gateways.
- E. Local Controllers: Wall-mounted, wired, containing temperature sensor.

## 2.03 EQUIPMENT

- A. All Units: Factory assembled, wired, and piped and factory tested for function and safety.
  1. Performance Certification: AHRI Certified; [www.ahrinet.org](http://www.ahrinet.org).
  2. Safety Certification: Tested to UL 1995 by UL or Intertek-ETL, listed in ITS (DIR), and bearing the certification label.
  3. Provide units capable of serving the zones indicated.
  4. Energy Efficiency: Report EER and COP based on tests conducted at "full load" in accordance with AHRI 210/240 or alternate test method approved by U.S. Department of Energy.
  5. Outdoor Units: Units and their supports designed and installed to resist wind pressures defined in ASCE 7.
- B. Electrical Characteristics: Refer to Drawings
- C. System Controls: As required to perform input functions necessary to operate system; provided by manufacturer of units.
  1. Provide interfaces to remote control and building automation systems as specified.
- D. Wiring:
  1. Control Wiring: 18 AWG, 2-conductor, non-shielded, non-polarized, stranded cable.
- E. Refrigerant Piping:
  1. Refrigerant Flow Balancing: Provide refrigerant piping joints and headers specifically designed to ensure proper refrigerant balance and flow for optimum system capacity and performance; T-style joints are prohibited.

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2. Insulate each refrigerant line individually between the condensing and indoor units.

#### **2.04 INDOOR/EVAPORATOR UNITS**

- A. All Indoor/Evaporator Units: Factory assembled and tested DX fan-coil units, with electronic proportional expansion valve, control circuit board, factory wiring and piping, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
  1. Refrigerant: Refrigerant circuits factory-charged with dehydrated air, for field charging.
  2. Temperature Control Mechanism: Return air thermistor and computerized Proportional-Integral-Derivative (PID) control of superheat.
  3. Coils: Direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond; waffle louver fin and high heat exchange, rifled bore tube design; factory tested.
    - a. Provide thermistor on liquid and gas lines.
  4. Fans: Direct-drive, with statically and dynamically balanced impellers; high and low speeds unless otherwise indicated; motor thermally protected.
  5. Return Air Filter: Washable long-life net filter with mildew proof resin, unless otherwise indicated.
  6. Condensate Drainage: Built-in condensate drain pan with PVC drain connection.
  7. Cabinet Insulation: Sound absorbing foamed polystyrene and polyethylene insulation.
- B. Wall Surface-Mounted Units: Finished white casing, with removable front grille; foamed polystyrene and polyethylene sound insulation; wall mounting plate; polystyrene condensate drain pan.
  1. Airflow Control: Auto-swing louver that closes automatically when unit stops; five (5) steps of discharge angle, set using remote controller; upon restart, discharge angle defaulting to same angle as previous operation.
  2. Condensate Pump: Built-in, concealed.
  3. Condensate Drain Connection: Back, with piping concealed in wall.
  4. Fan: Direct-drive cross-flow type.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that required electrical services have been installed and are in the proper locations prior to starting installation.
- B. Verify that condensate piping has been installed and is in the proper location prior to starting installation.
- C. Notify Architect if conditions for installation are unsatisfactory.

#### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install refrigerant piping in accordance with equipment manufacturer's instructions.
- C. Perform wiring in accordance with NFPA 70, National Electric Code (NEC).
- D. Coordinate with installers of systems and equipment connecting to this system.

#### **3.03 FIELD QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Provide manufacturer's field representative to inspect installation prior to startup.

#### **3.04 SYSTEM STARTUP**

- A. Prepare and start equipment and system in accordance with manufacturer's instructions and recommendations.
- B. Adjust equipment for proper operation within manufacturer's published tolerances.

#### **3.05 CLEANING**

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- A. Clean exposed components of dirt, finger marks, and other disfigurements.

**3.06 CLOSEOUT ACTIVITIES**

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Demonstrate proper operation of equipment to Owner's designated representative.
- D. Demonstration: Demonstrate operation of system to Owner's personnel.
  - 1. Use operation and maintenance data as reference during demonstration.
  - 2. Conduct walking tour of project.
  - 3. Briefly describe function, operation, and maintenance of each component.

**3.07 PROTECTION**

- A. Protect installed components from subsequent construction operations.
- B. Replace exposed components broken or otherwise damaged beyond repair.

**END OF SECTION**

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**SECTION 260505  
SELECTIVE DEMOLITION FOR ELECTRICAL**

**PART 1 GENERAL**

**2.01 SECTION INCLUDES**

- A. Electrical demolition.

**2.02 RELATED REQUIREMENTS**

- A. Section 017000 - Execution and Closeout Requirements: Additional requirements for alterations work.
- B. Section 028400 - 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 013000 - 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 017419 - 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**

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**SECTION 260519  
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. Armored cable.
- E. Power and control tray cable.
- F. Manufactured wiring systems.
- G. Wiring connectors.
- H. Electrical tape.
- I. Heat shrink tubing.
- J. Oxide inhibiting compound.
- K. Wire pulling lubricant.
- L. Cable ties.

**1.02 RELATED REQUIREMENTS**

- A. Section 078400 - Firestopping.
- B. Section 260505 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
- C. Section 260526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 284600 - Fire Detection and Alarm: Fire alarm system conductors and cables.
- F. Section 312316 - Excavation.

**1.03 REFERENCE STANDARDS**

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire 2013 (Reapproved 2018).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft 2011 (Reapproved 2017).
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation 2004 (Reapproved 2020).
- E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers 2005 (Reapproved 2021).
- F. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2017.
- G. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes 2020.
- H. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation) 2008a (Validated 2019).
- I. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- J. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable 2018.

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- K. NECA 121 - Standard for Installing Nonmetallic-Sheathed Cable (Type NM-B) and Underground Feeder and Branch-Circuit Cable (Type UF) 2007.
- L. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2021.
- M. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- N. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. UL 4 - Armored Cable Current Edition, Including All Revisions.
- P. UL 44 - Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.
- Q. UL 83 - Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.
- R. UL 486A-486B - Wire Connectors Current Edition, Including All Revisions.
- S. UL 486C - Splicing Wire Connectors Current Edition, Including All Revisions.
- T. UL 486D - Sealed Wire Connector Systems Current Edition, Including All Revisions.
- U. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables Current Edition, Including All Revisions.
- V. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.
- W. UL 719 - Nonmetallic-Sheathed Cables Current Edition, Including All Revisions.
- X. UL 854 - Service-Entrance Cables Current Edition, Including All Revisions.
- Y. UL 1277 - Electrical Power and Control Tray Cables with Optional Optical-Fiber Members Current Edition, Including All Revisions.
- Z. UL 1569 - Metal-Clad Cables Current Edition, Including All Revisions.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
  2. Coordinate 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 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. 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.

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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. 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 016000 - 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 NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

### 1.08 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

## PART 2 PRODUCTS

### 2.01 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
  - 1. Exceptions:
    - a. Use 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.
    - b. Use power and control tray cable or metal-clad cable for installation in cable tray.
- C. Nonmetallic-sheathed cable is not permitted.
- D. 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.



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- d. Where exposed to damage.
- e. For damp, wet, or corrosive locations.
- f. For isolated ground circuits.

E. Metal-clad cable is not permitted.

## 2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. 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 only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
  - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
  - 3. Tinned Copper Conductors: Comply with ASTM B33.
- H. Minimum Conductor Size: 12 AWG.
  - 1. Branch Circuits: 12 AWG.
    - a. Exceptions:
      - 1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
      - 2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
      - 3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
- I. Where conductor size is not indicated, size to comply with NFPA 70 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 NFPA 70 and is approved by the authority having jurisdiction.

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### 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 016000 - Product Requirements.
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
  - 1. Feeders and Branch Circuits:
    - a. Size 10 AWG and Smaller: Solid.
    - b. Size 8 AWG and Larger: Stranded.
  - 2. Control Circuits: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
  - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
    - a. Size 4 AWG and Larger: Type XHHW-2.
    - b. Installed Underground: Type XHHW-2.
    - c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.

### 2.04 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 016000 - Product Requirements.
- B. Description: NFPA 70, Type UF multiple-conductor cable listed and labeled as complying with UL 493, Type UF-B.
- C. Provide equipment grounding conductor unless otherwise indicated.
- D. Conductor Stranding:
  - 1. Size 10 AWG and Smaller: Solid.
  - 2. Size 8 AWG and Larger: Stranded.
- E. Insulation Voltage Rating: 600 V.
- F. Cable Jacket: Listed and labeled as sunlight resistant.

### 2.05 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 016000 - Product Requirements.
- B. Description: NFPA 70, 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.

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- 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.

## 2.06 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 016000 - Product Requirements.
- B. Description: NFPA 70, Type TC cable listed and labeled as complying with UL 1277.
- C. Where exposed run cable is indicated between cable tray and utilization equipment in qualifying industrial establishments as determined by authorities having jurisdiction, provide tray cable marked as Type TC-ER in accordance with NFPA 70.
- D. Conductor Stranding: Stranded.
- E. Insulation Voltage Rating: 600 V.
- F. Insulation: Type XHHW or XHHW-2.
- G. Grounding: Full-size integral equipment grounding conductor.
- H. Jacket: PVC or Chlorinated Polyethylene (CPE).

## 2.07 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 260526.
- C. Wiring Connectors for Splices and Taps:
  1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
  2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:
  1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
  2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
  3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
  4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
  5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
  6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
  7. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

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- 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 016000 - Product Requirements.
- H. 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 016000 - Product Requirements.
- I. 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 016000 - Product Requirements.
- J. 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).
    - d. Substitutions: See Section 016000 - Product Requirements.

## 2.08 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.

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- 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 016000 - 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 016000 - 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 016000 - 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 016000 - Product Requirements.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

#### **3.02 PREPARATION**

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

#### **3.03 INSTALLATION**

- A. Circuiting Requirements:
  - 1. Unless dimensioned, circuit routing indicated is diagrammatic.
  - 2. When circuit destination is indicated without specific routing, determine exact routing required.
  - 3. 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.

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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 underground feeder and branch-circuit cable (Type UF-B) in accordance with NECA 121.
- E. Install armored cable (Type AC) in accordance with NECA 120.
- F. 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.
- G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- H. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
- I. Terminate cables using suitable fittings.
  1. Armored Cable (Type AC):
    - a. Use listed fittings and anti-short, insulating bushings.
    - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
- J. Install conductors with a minimum of 12 inches of slack at each outlet.
- K. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- L. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- M. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- N. 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.

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- O. 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.
- P. Insulate ends of spare conductors using vinyl insulating electrical tape.
- Q. 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.
- R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- S. 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 014000 - 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**

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**SECTION 260526  
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.

**1.02 RELATED REQUIREMENTS**

- A. Section 096500 - Resilient Flooring: Static control flooring.
- B. Section 260519 - 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 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 265600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

**1.03 REFERENCE STANDARDS**

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings 2017.
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 99 - Health Care Facilities Code 2021, with Amendment.
- G. NFPA 780 - Standard for the Installation of Lightning Protection Systems 2023.
- H. UL 467 - Grounding and Bonding Equipment Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Verify exact locations of underground metal water service pipe entrances to building.
  - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
  - 3. For signal reference grids, coordinate the work with access flooring furnished in accordance with Section 096900.
  - 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 013000 - 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:



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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 NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

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

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

### **PART 2 PRODUCTS**

#### **2.01 GROUNDING AND BONDING REQUIREMENTS**

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. Grounding System Resistance:
  1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
  2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
  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. 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.

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2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
  3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
  4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
  5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
  6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
  7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
    - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
    - 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 NFPA 70 and NFPA 99.
- G. 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.
- H. 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 260526:
1. Use insulated copper conductors unless otherwise indicated.
    - a. Exceptions:

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- 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.
  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 016000 - 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.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

#### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
  1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
  2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.

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- 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 260553.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 014000 - 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**

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**SECTION 260529  
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 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- B. Section 260533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- C. Section 260533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- D. Section 265100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- E. Section 265133 - Luminaires, Ballasts, and Drivers - Lutron: Additional support and attachment requirements for luminaires.
- F. Section 265600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

**1.03 REFERENCE STANDARDS**

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.
- D. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position 2022.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.
- F. MFMA-4 - Metal Framing Standards Publication 2004.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- H. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 5B - Strut-Type Channel Raceways and Fittings Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.

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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 033000.

### 1.05 SUBMITTALS

- A. See Section 013000 - 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 NFPA 70.
- B. Comply with applicable building code.
- C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- D. Installer Qualifications for Field-Welding: As specified in Section 055000.
- 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.
  4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
  5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

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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 260548.
- C. Materials for Metal Fabricated Supports: Comply with Section 055000.
- 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 016000 - 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 016000 - 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 016000 - Product Requirements.
    - e. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
- 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.

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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 016000 - 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 016000 - 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.
    - 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.



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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 260548.
- 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 033000.
  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 260533.13.
- K. Box Support and Attachment: Also comply with Section 260533.16.
- L. Interior Luminaire Support and Attachment: Also comply with Section 265100.
- M. Exterior Luminaire Support and Attachment: Also comply with Section 265600.
- N. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- O. Secure fasteners according to manufacturer's recommended torque settings.
- P. Remove temporary supports.
- Q. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

### **3.03 FIELD QUALITY CONTROL**

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- A. See Section 014000 - 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**

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**SECTION 260533.13  
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 078400 - Firestopping.
- B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
- C. Section 260526 - Grounding and Bonding for Electrical Systems.
  - 1. Includes additional requirements for fittings for grounding and bonding.
- D. Section 260529 - Hangers and Supports for Electrical Systems.
- E. Section 260533.16 - Boxes for Electrical Systems.
- F. Section 260533.23 - Surface Raceways for Electrical Systems.
- G. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
- H. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- I. Section 262100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
- J. Section 271000 - Structured Cabling: Additional requirements for communications systems conduits.
- K. Section 312316 - Excavation.
- L. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.

**1.03 REFERENCE STANDARDS**

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC) 2020.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S) 2020.
- C. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A) 2020.
- D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit 2018.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

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- F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2020.
- G. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) 2017.
- H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- I. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit 2018.
- J. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit 2020.
- K. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing 2021.
- L. NEMA TC 13 - Electrical Nonmetallic Tubing (ENT) 2014 (Reaffirmed 2019).
- M. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. UL 1 - Flexible Metal Conduit Current Edition, Including All Revisions.
- O. UL 6 - Electrical Rigid Metal Conduit-Steel Current Edition, Including All Revisions.
- P. UL 360 - Liquid-Tight Flexible Metal Conduit Current Edition, Including All Revisions.
- Q. UL 514B - Conduit, Tubing, and Cable Fittings Current Edition, Including All Revisions.
- R. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings Current Edition, Including All Revisions.
- S. UL 797 - Electrical Metallic Tubing-Steel Current Edition, Including All Revisions.
- T. UL 1242 - Electrical Intermediate Metal Conduit-Steel Current Edition, Including All Revisions.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
  2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
  4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
  5. Notify Architect of any conflicts with or deviations from 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 013000 - 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.

#### **1.06 QUALITY ASSURANCE**

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- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
  1. 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).
  2. 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).
  3. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
  4. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.
  5. 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.
  6. 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).
  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

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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 262100.
- C. Communications Systems Conduits: Also comply with Section 271000.
- D. Fittings for Grounding and Bonding: Also comply with Section 260526.
- 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 NFPA 70 but not less than applicable minimum size requirements specified.

## 2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
  - 1. Allied Tube & Conduit: [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 016000 - Product Requirements.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
  - 1. Manufacturers:
    - a. Bridgeport Fittings Inc: [www.bptfittings.com/#sle](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 016000 - 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.

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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 016000 - Product Requirements.
- B. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.
- C. Fittings:
  1. Manufacturers:
    - a. Bridgeport Fittings Inc: [www.bptfittings.com/#sle](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 016000 - 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 016000 - Product Requirements.
- B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- C. Fittings:
  1. Manufacturers:
    - a. Bridgeport Fittings Inc: [www.bptfittings.com/#sle](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 016000 - 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:
  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 016000 - Product Requirements.

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- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.
- D. Interior Coating: Urethane, minimum thickness of 2 mil.
- E. PVC-Coated Fittings:
  - 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
  - 2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
  - 3. 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 016000 - Product Requirements.
- B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- C. Fittings:
  - 1. Manufacturers:
    - a. Bridgeport Fittings Inc: [www.bptfittings.com/#sle](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 016000 - Product Requirements.
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
  - 1. Manufacturers:
    - a. Bridgeport Fittings Inc [www.bptfittings.com/#sle](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 016000 - 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)

- 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).



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3. Wheatland Tube, a Division of Zekelman Industries: [www.wheatland.com/#sle](http://www.wheatland.com/#sle).
  4. Substitutions: See Section 016000 - Product Requirements.
- B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
1. Manufacturers:
    - a. Bridgeport Fittings Inc [www.bptfittings.com/#sle](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 016000 - 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.
  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 016000 - Product Requirements.
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
1. Manufacturer: Same as manufacturer of conduit to be connected.
  2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

## 2.11 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)

- A. Description: NFPA 70, 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.
- 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.

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- 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 016000 - 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 016000 - 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.
  - 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.

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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 NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
  2. Provide required vibration isolation and/or seismic controls in accordance with Section 260548.
  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 NFPA 70 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.
  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.

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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 078400.
- L. Underground Installation:
1. Provide trenching and backfilling in accordance with Section 312316.13.
  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 260553 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 033000 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 NFPA 70.
- 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 NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
  3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
  4. Where conduits are subject to earth movement by settlement or frost.

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- 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 260526.
- T. Identify conduits in accordance with Section 260553.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 014000 - 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**

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**SECTION 260533.16  
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.

**1.02 RELATED REQUIREMENTS**

- A. Section 078400 - Firestopping.
- B. Section 083100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- C. Section 260526 - Grounding and Bonding for Electrical Systems.
- D. Section 260529 - Hangers and Supports for Electrical Systems.
- E. Section 260533.13 - 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.
- F. Section 260533.23 - Surface Raceways for Electrical Systems:
  - 1. Accessory boxes designed specifically for surface raceway systems.
  - 2. Lay-in wireways and wiring troughs with removable covers.
- G. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
- H. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- I. Section 262726 - Wiring Devices:
  - 1. Wall plates.
  - 2. Access floor boxes.
  - 3. Additional requirements for locating boxes for wiring devices.
- J. Section 262813 - Fuses: Spare fuse cabinets.
- K. Section 271000 - Structured Cabling: Additional requirements for communications systems outlet boxes.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports 2013 (Reaffirmed 2020).
- E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports 2013 (Reaffirmed 2020).
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. SCTE 77 - Specifications for Underground Enclosure Integrity 2017.

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- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- J. UL 508A - Industrial Control Panels Current Edition, Including All Revisions.
- K. UL 514A - Metallic Outlet Boxes Current Edition, Including All Revisions.
- L. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers Current Edition, Including All Revisions.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
  - 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
  - 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
  - 6. Coordinate the work with other trades to preserve insulation integrity.
  - 7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
  - 8. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

#### 1.05 SUBMITTALS

- A. See Section 013000 - 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 016000 - Product Requirements, for additional provisions.
  - 2. Keys for Lockable Enclosures: Two of each different key.

#### 1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

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## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.01 BOXES

- A. General Requirements:
1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
  2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
  3. Provide products listed, classified, and labeled as suitable for the purpose intended.
  4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
  5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
  2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
  3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
  4. Use cast aluminum boxes where aluminum rigid metal conduit is used.
  5. Use nonmetallic boxes where exposed rigid PVC conduit is used.
  6. Use suitable concrete type boxes where flush-mounted in concrete.
  7. Use suitable masonry type boxes where flush-mounted in masonry walls.
  8. Use raised covers suitable for the type of wall construction and device configuration where required.
  9. Use shallow boxes where required by the type of wall construction.
  10. Do not use "through-wall" boxes designed for access from both sides of wall.
  11. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
  12. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
  13. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
  14. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
  15. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
  16. Minimum Box Size, Unless Otherwise Indicated:
    - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
    - b. Communications Systems Outlets: Comply with Section 271000.
  17. Wall Plates: Comply with Section 262726.
  18. Manufacturers:
    - a. Cooper Crouse-Hinds, a division of Eaton Corporation: [www.cooperindustries.com/#sle](http://www.cooperindustries.com/#sle).
    - b. Hubbell Incorporated; Bell Products: [www.hubbell-rtb.com/#sle](http://www.hubbell-rtb.com/#sle).
    - c. Hubbell Incorporated; RACO Products: [www.hubbell-rtb.com/#sle](http://www.hubbell-rtb.com/#sle).
    - d. O-Z/Gedney, a brand of Emerson Electric Co: [www.emerson.com/#sle](http://www.emerson.com/#sle).
    - e. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).



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- f. Substitutions: See Section 016000 - 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](http://www.cooperindustries.com/#sle).
    - b. Hoffman, a brand of Pentair Technical Products: [www.hoffmanonline.com/#sle](http://www.hoffmanonline.com/#sle).
    - c. Hubbell Incorporated; Wiegmann Products: [www.hubbell-wiegmann.com/#sle](http://www.hubbell-wiegmann.com/#sle).
    - d. Substitutions: See Section 016000 - 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](http://www.hubbell.com/#sle).
    - b. Substitutions: See Section 016000 - 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](http://www.emerson.com/#sle).
    - b. Cooper Crouse-Hinds, a division of Eaton Corporation: [www.cooperindustries.com/#sle](http://www.cooperindustries.com/#sle).
    - c. Hubbell Incorporated; Killark Products: [www.hubbell-killark.com/#sle](http://www.hubbell-killark.com/#sle).
    - d. Substitutions: See Section 016000 - Product Requirements.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.

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- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations:
  - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 083100 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 262726.
    - b. Communications Systems Outlets: Comply with Section 271000.
  - 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 260533.13.
  - 11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    - a. Concealed above accessible suspended ceilings.
    - b. Within joists in areas with no ceiling.
    - c. Electrical rooms.
    - d. Mechanical equipment rooms.
- I. Box Supports:
  - 1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
  - 2. Provide required seismic controls in accordance with Section 260548.
  - 3. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
  - 4. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
  - 5. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.
- J. Install boxes plumb and level.
- K. Flush-Mounted Boxes:
  - 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface

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- 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.
- L. Floor-Mounted Cabinets: Mount on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.
- 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. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- R. Close unused box openings.
- S. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- T. Provide grounding and bonding in accordance with Section 260526.
- U. Identify boxes in accordance with Section 260553.

### **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**

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**SECTION 260533.23  
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 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
  - 1. Includes metal channel (strut) used as raceway.
- C. Section 260533.13 - Conduit for Electrical Systems.
- D. Section 260533.16 - Boxes for Electrical Systems.
- E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 262726 - Wiring Devices: Receptacles.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- D. NEMA PRP 5 - Installation Guidelines for Surface Nonmetallic Raceway 2021.
- E. UL 5 - Surface Metal Raceways and Fittings Current Edition, Including All Revisions.
- F. UL 5A - Nonmetallic Surface Raceways and Fittings Current Edition, Including All Revisions.
- G. UL 111 - Outline of Investigation for Multioutlet Assemblies Current Edition, Including All Revisions.
- H. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate the placement of raceways with millwork, furniture, equipment, etc. installed under other sections or by others.
  - 2. Coordinate rough-in locations of outlet boxes provided under Section 260533.16 and conduit provided under Section 260533.13 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**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

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- 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 NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

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

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

### **PART 2 PRODUCTS**

#### **2.01 RACEWAY REQUIREMENTS**

- A. Provide all components, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

#### **2.02 SURFACE RACEWAY SYSTEMS**

- A. Manufacturers:
  - 1. Hubbell Incorporated: [www.hubbell.com/#sle](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 016000 - 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 260529.
- F. Surface Raceway System:
  - 1. Raceway Type: Single channel, painted steel.
  - 2. Length: As indicated on the drawings.
  - 3. Color: To be selected by Architect.
  - 4. Accessory Device Boxes: Suitable for the devices to be installed; color to match raceway.

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5. Integrated Device Provisions:
  - a. Receptacles:
    - 1) Comply with Section 262726, 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 271000.
    - 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 016000 - 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 016000 - Product Requirements.
- B. Description: Lay-in wireways and wiring troughs with removable covers; listed and labeled as complying with UL 870.
- C. Wireway Type, Unless Otherwise Indicated:
  1. Indoor Clean, Dry Locations: NEMA 250, Type 1, painted steel with screw-cover.
  2. Outdoor Locations: NEMA 250, Type 3R, painted steel with screw-cover; include provision for padlocking.
- D. Finish for Painted Steel Wireways: Manufacturer's standard grey unless otherwise indicated.
- E. Minimum Wireway Size: 4 by 4 inches unless otherwise indicated.
- F. Where wireway size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

### 2.04 WALL DUCT

- A. Manufacturers:
  1. Dennis Filges Company, Inc: [www.filgesco.com/#sle](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 016000 - Product Requirements.
  6. Source Limitations: Where the wall duct system includes connections to trench duct as specified in Section 260539, furnish wall duct and associated components produced by the same manufacturer as the trench duct to be installed.
- B. Description: Metal raceways specifically designed for enclosure of wiring to X-ray machines and similar medical equipment; listed and labeled as complying with UL 870.
- C. Material: Steel, unless otherwise indicated.
- D. Mounting Provisions: Suitable for surface- or flush-mounting as indicated.
- E. Size: As indicated on the drawings.

### 2.05 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.

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- B. Factory test each production unit for pre-wired surface raceway systems to verify proper wiring.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes and conduit terminations are installed in proper locations and are properly sized in accordance with NFPA 70 to accommodate raceways.
- C. Verify that mounting surfaces are ready to receive raceways and that final surface finishes are complete, including painting.
- D. Verify that conditions are satisfactory for installation prior to starting work.

#### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install raceways plumb and level.
- D. Arrange wireways and associated raceway connections to comply with NFPA 70, including but not limited to requirements for deflected conductors and wireways used as pullboxes. Increase size of wireway where necessary.
- E. Secure and support raceways in accordance with Section 260529 at intervals complying with NFPA 70 and manufacturer's requirements.
- F. Close unused raceway openings.
- G. Provide grounding and bonding in accordance with Section 260526.
- H. Identify raceways in accordance with Section 260553.

#### **3.03 FIELD QUALITY CONTROL**

- A. See Section 014000 - 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**

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**SECTION 260553  
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 099113 - Exterior Painting.
- B. Section 099123 - Interior Painting.
- C. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

**1.03 REFERENCE STANDARDS**

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs 2011 (Reaffirmed 2017).
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels 2011 (Reaffirmed 2017).
- C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace 2021.
- E. UL 969 - Marking and Labeling Systems Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
  - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
  - 2. Do not install identification products until final surface finishes and painting are complete.

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- 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.



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## 1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

## 1.07 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

## PART 2 PRODUCTS

### 2.01 IDENTIFICATION REQUIREMENTS

- A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.
- B. Identification for Equipment:
  1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
    - a. 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.
  2. Emergency System Equipment:
    - a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
    - b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
    - c. Use identification nameplate to identify emergency operating instructions for emergency system equipment.
  3. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
  4. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
  5. Use identification nameplate to identify switchboards and panelboards utilizing a high leg delta system in accordance with NFPA 70.
  6. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
  7. 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.
  8. 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.
  9. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
  10. 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 099123 and 099113.
  11. 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.
  12. 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".

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13. 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".
  14. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.
- C. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
  2. Identification for Communications Conductors and Cables: Comply with Section 271000.
  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 099123 and 099113.
        - 3) Vinyl Color Coding Electrical Tape: Comply with Section 260519.
  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 260536.
- 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 099123 and 099113 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.

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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 271000.
2. Wiring Device and Wallplate Finishes: Comply with Section 262726.
3. Factory Pre-Marked Wallplates: Comply with Section 262726.
4. Use identification label to identify fire alarm system devices.
  - a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
5. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
  - a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
6. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
7. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

H. Identification for Luminaires:

1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

## 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 016000 - 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 016000 - Product Requirements.
2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
  - a. Use only for indoor locations.
3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

- C. Format for Equipment Identification:
1. Minimum Size: 1 inch by 2.5 inches.
  2. Legend:
    - a. System designation where applicable:
      - 1) Emergency Power System: Identify with text "EMERGENCY".
      - 2) Fire Alarm System: Identify with text "FIRE ALARM".
    - b. Equipment designation or other approved description.
    - c. Other information as indicated.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height:
    - a. System Designation: 1 inch.
    - b. Equipment Designation: 1/2 inch.
    - c. Other Information: 1/4 inch.
    - d. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
  5. Color:
    - a. Normal Power System: White text on black background.
    - b. Emergency Power System: White text on red background.
    - c. Fire Alarm System: White text on red background.
- D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch by 2.5 inches.
  2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
  3. Text: All capitalized unless otherwise indicated.
  4. Minimum Text Height: 1/4 inch.
  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:

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1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Designation indicated and device zone or address.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Red text on white background.

### 2.03 WIRE AND CABLE MARKERS

- A. Manufacturers:
  1. Brady Corporation: [www.bradyid.com/#sle](http://www.bradyid.com/#sle).
  2. HellermannTyton: [www.hellermanntyton.com/#sle](http://www.hellermanntyton.com/#sle).
  3. Panduit Corp: [www.panduit.com/#sle](http://www.panduit.com/#sle).
  4. Substitutions: See Section 016000 - 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.

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1. Exception: Use foil-backed detectable type tape where required by serving utility or where directed by Owner.
- C. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
- D. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- E. Legend: Type of service, continuously repeated over full length of tape.
- F. Color:
  1. Tape for Buried Power Lines: Black text on red background.
  2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

## 2.06 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 016000 - 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 014000 - 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**

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**SECTION 260583  
WIRING CONNECTIONS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Electrical connections to equipment.

**1.02 RELATED REQUIREMENTS**

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 260533.13 - Conduit for Electrical Systems.
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 262726 - Wiring Devices.
- E. Section 262816.16 - Enclosed Switches.

**1.03 REFERENCE STANDARDS**

- A. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2020).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2021.
- C. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
  - 2. Determine connection locations and requirements.
- B. Sequencing:
  - 1. Install rough-in of electrical connections before installation of equipment is required.
  - 2. Make electrical connections before required start-up of equipment.

**1.05 SUBMITTALS**

- A. See Section 013000 - 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 NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
  - 1. Colors: Conform to NEMA WD 1.
  - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
  - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches: As specified in Section 262816.16 and in individual equipment sections.
- C. Wiring Devices: As specified in Section 262726.



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- D. Flexible Conduit: As specified in Section 260533.13.
- E. Wire and Cable: As specified in Section 260519.
- F. Boxes: As specified in Section 260533.16.

### **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**

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**SECTION 260923  
LIGHTING CONTROL DEVICES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Occupancy sensors.
- B. Daylighting controls.
- C. Control accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 262726 - 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.
- F. Section 262813 - Fuses.
- G. Section 262913 - Enclosed Controllers : General purpose contactors.
- H. Section 265100 - Interior Lighting.
- I. Section 265600 - Exterior Lighting.

**1.03 REFERENCE STANDARDS**

- A. 47 CFR 15 - Radio Frequency Devices current edition.
- B. 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 2017.
- C. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols 2020.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- E. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- G. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts 2020.
- H. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts 2008 (Reaffirmed 2020).
- I. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices 2017.
- J. NEMA ICS 6 - Industrial Control and Systems: Enclosures 1993 (Reaffirmed 2016).
- K. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting Current Edition, Including All Revisions.
- M. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control Current Edition, Including All Revisions.
- N. UL 916 - Energy Management Equipment Current Edition, Including All Revisions.

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- O. UL 917 - Clock-Operated Switches Current Edition, Including All Revisions.
- P. UL 1472 - Solid-State Dimming Controls Current Edition, Including All Revisions.
- Q. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules Current Edition, Including All Revisions.
- R. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters Current Edition, Including All Revisions.

#### 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 013000 - 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.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 016000 - 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

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- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### **1.07 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 017800 - 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. nLight: [www.nlight.com/#sle](http://www.nlight.com/#sle).
  2. WattStopper: [www.wattstopper.com/#sle](http://www.wattstopper.com/#sle).
  3. Substitutions: See Section 016000 - Product Requirements.
  4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. All Occupancy Sensors:
  1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
  2. Sensor Technology:
    - a. Passive Infrared (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.

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- 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.
    - 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 262726, unless otherwise indicated.
    - h. Provide vandal resistant lenses for passive infrared (PIR) and dual technology wall switch occupancy sensors where indicated.

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2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
- 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 262726, 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) Lutron Maestro C.L Sensor Dimmer Series; [www.lutron.com/#sle](http://www.lutron.com/#sle).
      - 2) Lutron Maestro Occupancy Sensor Dimmer Series; [www.lutron.com/#sle](http://www.lutron.com/#sle).
      - 3) Lutron Maestro 0-10V Dimmer Sensor Series; [www.lutron.com/#sle](http://www.lutron.com/#sle).
      - 4) Substitutions: See Section 016000 - Product Requirements.
- E. Ceiling Mounted Occupancy Sensors:
1. All Ceiling Mounted Occupancy Sensors:
    - a. Description: Low profile occupancy sensors designed for ceiling installation.
    - b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
    - c. Provide field selectable setting for disabling LED motion detector visual indicator.
    - d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
    - e. Finish: White unless otherwise indicated.
  2. Passive Infrared (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) Lutron LOS-CIR Series; [www.lutron.com/#sle](http://www.lutron.com/#sle).
        - (b) Lutron Radio Powr Savr Wireless Sensors; [www.lutron.com/#sle](http://www.lutron.com/#sle).
    - 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) Lutron LOS-CUS Series; [www.lutron.com/#sle](http://www.lutron.com/#sle).
  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) Lutron LOS-CUS Series; [www.lutron.com/#sle](http://www.lutron.com/#sle).
    - 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:

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- (a) Lutron LOS-CUS Series; [www.lutron.com/#sle](http://www.lutron.com/#sle).
    - c. Extended Range Sensors: Capable of detecting motion within an area of 2,000 square feet at a mounting height of 9 feet.
      - 1) Products:
        - (a) Lutron LOS-CUS Series; [www.lutron.com/#sle](http://www.lutron.com/#sle).
  - 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) Lutron LOS-CDT Series; [www.lutron.com/#sle](http://www.lutron.com/#sle).
    - 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) Lutron LOS-CDT Series; [www.lutron.com/#sle](http://www.lutron.com/#sle).
  - 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.
    - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet.
- 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.
- G. Power Packs for Low Voltage Occupancy Sensors:
  - 1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
  - 2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
  - 3. Input Supply Voltage: Dual rated for 120/277 V ac.
  - 4. Load Rating: As required to control the load indicated on drawings.
- H. 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 DAYLIGHTING CONTROLS

- A. Manufacturers:
  - 1. nLight: [www.nlight.com/#sle](http://www.nlight.com/#sle).
  - 2. WattStopper: [www.wattstopper.com/#sle](http://www.wattstopper.com/#sle).
- B. 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.
- C. 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.

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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. Skylight Photo Sensors: 1,000 to 6,000 footcandles.
  - d. 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).
- D. Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming ballasts, for direct continuous dimming of up to 50 ballasts.
- E. 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.
- F. 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.
  6. Load Rating: As required to control the load indicated on drawings.
- G. 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.
  3. Dimming and Fade Rates: Adjustable from 5 to 60 seconds.
  4. Cut-Off Delay: Selectable and adjustable from 0 to 20 minutes.



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- H. 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.
- I. 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.
- J. 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).

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 PREPARATION**

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### **3.03 INSTALLATION**

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 260533.16 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.

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- 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 262726.
- G. Provide required supports in accordance with Section 260529.
- 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 260553.
- J. Occupancy Sensor Locations:
  - 1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Architect.
- K. Daylighting Control Photo Sensor Locations:
  - 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.
- L. 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.
- M. 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.
- N. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.
- O. 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 014000 - 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.

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- 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 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 019113 - General Commissioning Requirements for commissioning requirements.

### **3.08 CLOSEOUT ACTIVITIES**

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - 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**

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## **SECTION 262726 WIRING DEVICES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Wall plates.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 260533.23 - Surface Raceways for Electrical Systems: Surface raceway systems, including multioutlet assemblies.
- E. Section 260539 - Underfloor Raceways for Electrical Systems.
- F. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- G. Section 260583 - Wiring Connections: Cords and plugs for equipment.
- H. Section 260923 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.

#### **1.03 REFERENCE STANDARDS**

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for 2014h, with Amendments (2017).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification) 2014g, with Amendment (2017).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2020).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2021.
- G. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interrupters Current Edition, Including All Revisions.
- L. UL 1449 - Standard for Surge Protective Devices Current Edition, Including All Revisions.
- M. UL 1472 - Solid-State Dimming Controls Current Edition, Including All Revisions.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
  - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.

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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 013000 - 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 016000 - 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 NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

**1.07 DELIVERY, STORAGE, AND PROTECTION**

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- 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 GFCI protection for receptacles installed within 6 feet of sinks.
- E. Provide GFCI protection for receptacles serving electric drinking fountains.
- F. Provide isolated ground receptacles for receptacles serving computers and electronic cash registers.
- G. Unless noted otherwise, do not use combination switch/receptacle devices.
- H. For flush floor service fittings, use tile rings for installations in tile floors.
- I. 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. 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).
- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable FS W-S-896; types as indicated on the drawings.
  1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

### **2.04 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

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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 016000 - 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.

### 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 NFPA 70; 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.

### 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

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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.
- 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 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 016000 - 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 016000 - 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 096900.



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- 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 260519.
- 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 NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that 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.
- 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 260533.16 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

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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.
- 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 260553.
- 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 014000 - 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.

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**END OF SECTION**

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**SECTION 262813  
FUSES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fuses.
- B. Spare fuse cabinet.

**1.02 RELATED REQUIREMENTS**

- A. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- B. Section 262816.16 - Enclosed Switches: Fusible switches.

**1.03 REFERENCE STANDARDS**

- A. NEMA FU 1 - Low Voltage Cartridge Fuses 2012.
- B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements Current Edition, Including All Revisions.
- D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses Current Edition, Including All Revisions.
- E. UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses Current Edition, Including All Revisions.
- F. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses Current Edition, Including All Revisions.
- G. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses Current Edition, Including All Revisions.
- H. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
    - a. Fusible Enclosed Switches: See Section 262816.16.
  - 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 013000 - 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 016000 - Product Requirements, for additional provisions.
  - 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 NFPA 70.

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- 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 016000 - 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**

### **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.

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- 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 260553.

**END OF SECTION**

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**SECTION 262816.16  
ENCLOSED SWITCHES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Enclosed safety switches.

**1.02 RELATED REQUIREMENTS**

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 262813 - Fuses.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum) 2013.
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches Current Edition, Including All Revisions.
- I. UL 869A - Reference Standard for Service Equipment Current Edition, Including All Revisions.

**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 NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  - 1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
  - 2. Include wiring diagrams showing all factory and field connections.
  - 3. Identify mounting conditions required for equipment seismic qualification.

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- 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 016000 - Product Requirements, for additional provisions.
  - 2. See Section 262813 for requirements for spare fuses and spare fuse cabinets.

#### **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: 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. General Electric Company: [www.geindustrial.com/#sle](http://www.geindustrial.com/#sle).
- B. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

### **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 016000 - 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.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.



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- C. Seismic Qualification: Provide enclosed safety switches suitable for application under the seismic design criteria specified in Section 260548 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. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
    - c. 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.
  - 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.

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- Q. 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 NFPA 70.
- D. Provide required support and attachment in accordance with Section 260529.
- 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 260526.
- H. Provide fuses complying with Section 262813 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 260553.

#### **3.03 FIELD QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

#### **3.04 ADJUSTING**

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

#### **3.05 CLEANING**

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- 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**

**SECTION 265100  
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 260529 - Hangers and Supports for Electrical Systems.
- B. Section 260533.16 - Boxes for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 260923 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors and daylighting controls.
- E. Section 262726 - Wiring Devices: Manual wall switches and wall dimmers.
- F. Section 265600 - Exterior Lighting.

**1.03 REFERENCE STANDARDS**

- A. 47 CFR 15 - Radio Frequency Devices current edition.
- B. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code) 2013 (Corrigendum 2019).
- C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits 2002 (Corrigendum 2012).
- D. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information 2019.
- E. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products 2019.
- F. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources 2021.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- H. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems 2006.
- I. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems 1999 (Reaffirmed 2006).
- J. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts 2020.
- K. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility 2012 (Reaffirmed 2018).
- L. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. UL 844 - Luminaires for Use in Hazardous (Classified) Locations Current Edition, Including All Revisions.
- O. UL 924 - Emergency Lighting and Power Equipment Current Edition, Including All Revisions.
- P. UL 1598 - Luminaires Current Edition, Including All Revisions.

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- Q. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products Current Edition, Including All Revisions.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
  2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
  3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
  4. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

#### 1.05 SUBMITTALS

- A. See Section 013000 - 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 016000 - 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

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- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### **1.07 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 017800 - 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 NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the 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.

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- b. Designed for field cutting in accordance with listing.
- c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.
- 2. White LED Tape:
  - a. Color Rendering Index (CRI): Not less than 90.
- J. 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 NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### 3.03 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 260533.16 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 260529.
- F. Provide required seismic controls in accordance with Section 260548.
- 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 circuit indicated. 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 260553.
- Q. Install lamps in each luminaire.

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

- A. See Section 014000 - 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 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - 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**

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**SECTION 265600  
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 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
- E. Section 262726 - Wiring Devices: Receptacles for installation in poles.
- F. Section 265100 - Interior Lighting.

**1.03 REFERENCE STANDARDS**

- A. 47 CFR 15 - Radio Frequency Devices current edition.
- B. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals 2013, with Editorial Revision (2022).
- C. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing 2017.
- D. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code) 2013 (Corrigendum 2019).
- E. IEEE C2 - National Electrical Safety Code(R) (NEC(R)) 2023.
- F. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits 2002 (Corrigendum 2012).
- G. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information 2019.
- H. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products 2019.
- I. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources 2021.
- J. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- K. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems 2000 (Reaffirmed 2006).
- L. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility 2012 (Reaffirmed 2018).
- M. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. UL 1598 - Luminaires Current Edition, Including All Revisions.
- O. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits Current Edition, Including All Revisions.
- P. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:

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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 013000 - 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 016000 - 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.
  5. Touch-Up Paint: 2 gallons, to match color of pole finish.

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- 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 NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

**1.08 WARRANTY**

- A. See Section 017800 - 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 NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. 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.
    - c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.

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- 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 NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 PREPARATION

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- 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 260533.16 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 260529.
- F. Provide required seismic controls in accordance with Section 260548.
- 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 033000.
      - 1) Install anchor bolts plumb per template furnished by pole manufacturer.
      - 2) Position conduits to enter pole shaft.
    - b. Install foundations plumb.
    - c. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
    - d. Tighten anchor bolt nuts to manufacturer's recommended torque.
    - e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.
    - f. Install anchor base covers or anchor bolt covers as indicated.
  - 3. Embedded Poles: Install poles plumb as indicated.
  - 4. Grounding:
    - a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
    - b. Provide supplementary ground rod electrode as specified in Section 260526 at each pole bonded to grounding system as indicated.

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- 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 262813 in pole handhole or transformer base for each ungrounded conductor.
- 7. Install weather resistant GFI duplex receptacle with weatherproof cover as specified in Section 262726 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 014000 - 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 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - 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**

**SECTION 27 10 00**

**STRUCTURED TELECOMMUNICATIONS CABLING AND PATHWAYS**

PART 1 - GENERAL

1.1 RELATED WORK

The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.

- A. Conditions of the Contract
- B. Division 1
- C. Division 26
- D. Division 27
- E. Division 28

1.2 DESCRIPTION

A. Summary of Work:

1. **Reference Attachment 'A' of this specification for supplemental scope as it relates to the project and the Owner standards.**
2. Provide a complete and tested Structured Cabling System (SCS) for the interconnections of the Local Area Network (LAN). The SCS shall include fully terminated unshielded twisted pair cables, fiber optic cabling, raceways, conduit, back boxes, copper/fiber optic termination components, station mounting hardware, fiber optic enclosures, patch panels, copper/fiber optic patch cables, relay cabinets/cabinets, and other incidental and miscellaneous premises wiring system hardware as required for a complete, tested, and usable system that is in compliance with the latest NEC, ANSI/EIA/TIA, BICSI, and Authorities Having Jurisdiction codes and standards. The installation shall comply with all applicable requirements, design guidelines, and standards in effect at the job site and as indicated in the Drawings and Specifications.
3. An IDF will be required when the distance between outlet terminations and MDF/IDF exceeds 280', including service loops. IDF's shall be selected and organized to be minimum in number while still reaching all locations to be wired.
4. If there are any discrepancies between the drawings and specification or among themselves, the contractor shall request clarification prior to providing pricing for the scope of work. If a request is not issued and a response not provided via a posted addendum, the contractor shall provide pricing for the costliest scenario and obtain clarification during the project.
5. These documents are conceptual in nature. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system and documents accepted do not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.3 QUALITY ASSURANCE

A. Acceptable manufacturers:

1. The equipment/products described herein and furnished per these specifications shall be the product of one manufacturer or must be able to obtain the full warranty



of the combined solution. All references to model numbers and other detailed descriptive data is intended to establish standards of design performance, and quality, as required. The contractor shall not deviate from the part numbers listed. Any deviation from specified part numbers will result in the removal of non-specified materials and reinstallation of approved materials at no cost to the project.

2. The approved manufacturers shall provide a complete End-to-End solution with the maximum product and performance warranty offered by the specified manufacturer.
3. Only products listed in Attachment 'B' or approved in compliance with the project manual's approval requirements will be accepted.

B. Installer Qualifications:

1. The Data Cable System Installer shall be licensed and shall meet all applicable regulations of the State Department of Labor insofar as they apply to this type of system. The proposer shall be a firm normally employed in the low voltage and data cabling industry and shall provide a reference list of ten (10) large-scale projects and contact names confirming successful Structure Cabling System installations.
2. The SCS Installer shall be a Certified, local area, integrator of the manufacturer's product and must be able to provide the manufacturer's maximum available warranty for the solution on the entire SCS. The contractor's certification must have been obtained and held within 75 miles of the project's location.
3. The installing contractor must have a full-time employed RCDD (Registered Communications Distribution Designer) on staff. Current RCDD certification shall be provided in the product submittals.
4. All individuals installing the SCS must be employees of the certified installer and at least 25% of the installing staff shall have undergone a training class given by the manufacturer. Current certification indicating the successful completion of the training course shall be available upon request at the project and submitted in the contractor's product submittals.
5. The proposing contractor and the installing contractor must be the same company. No subcontractor to the proposing SCS contractor will be allowed for any portion of the SCS scope of work.

C. Low Voltage Meeting Requirements:

1. The successful Contractor shall attend a mandatory pre-construction meeting with the project's consultant individuals deemed necessary by the Owner's representative prior to the start of the work. No SCS work shall begin prior to this meeting.
2. The successful contractor shall attend a mandatory bi-weekly meeting to discuss the project progress to help aid coordination with the Owner and Other contractors.
3. Prior to the installation of any items required for this scope of work the contractor must provide a purchase order with a detailed material list for all materials to be installed. The purchase order is not required to show cost, but part numbers must be provided. The purchase order will be reviewed during one of the regularly scheduled low voltage meetings.

D. Acceptance:

1. The Owner's representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.

E. Warranty:

1. The selected system installer shall be a certified installing contractor of product and hold current certification. Contractor shall provide the specified manufacturer's

maximum end-to-end performance warranty on all products installed. The proposer shall provide current certification documentation. The performance warranty shall be issued by the manufacturer and shall warrant that ALL cable links have been tested bi-directionally (end to end) using a Level IIIe or better tester, per TSB-67, and that all test results conform to the most current ANSI/TIA-568.2-D.

2. The warranty will also cover multimode fiber optic cabling. Performance testing shall be conducted in accordance with ANSI/EIA/TIA-526-14 Standard, method B.
3. The warranty will stipulate that all products used in this installation meet the prescribed mechanical and transmission specifications for such products as described in ANSI/TIA/EIA-568.3-D. Quality and workmanship evaluation shall be solely by the Owner/Designer and designated representatives.

#### 1.4 REGULATORY REQUIREMENTS

A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:

1. Latest Local Codes and Amendments
2. National Electrical Code, current version

B. Other References:

1. ANSI/TIA-568-C.0 – Generic Communications Cabling for Customer Premises...
2. ANSI/TIA-568-C.1 – Commercial Building Communications Cabling Standard Part 1: General Requirements.
3. ANSI/TIA 568-C.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards
4. ANSI/TIA 568-C.3 – Optical Fiber Cabling Components Standard
5. ANSI/TIA-568-C.4, Coaxial Cabling Component Standard
6. ANSI/TIA-569-C – Commercial Building Standard for Telecommunications Pathways and Spaces.
7. ANSI/TIA-492.AAAC-B – Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class 1a Graded-index Multimode Optical Fibers (OM3/OM4). Current Edition
8. ANSI/ICEA S-83-596, Fiber Optic Premises Distribution Cable.
9. ANSI/TIA/EIA-598, Color Coding of Optical Fiber Cables
10. ANSI/ICEA S-87-640, Fiber Optic Outside Plant Distribution Cable.
11. ANSI/TIA/EIA-758: Customer-Owned Outside Plant Telecommunications Cabling Standard.
12. ANSI/TIA/EIA-526-7, Optical Power Loss Measurements of Installed Single mode Fiber Plant: OFSTP-7.
13. ANSI/TIA/EIA-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Plant: OFSTP-14A
14. ANSI/TIA/EIA-TSB-125, Guidelines for Maintaining Optical Fiber Polarity Through Reverse-Pair Positioning
15. ANSI/TIA/EIA-TSB-140, Additional Guidelines for Field Testing Length, Loss, and Polarity of Optical Fiber Cabling Systems.
16. ANSI/TIA-606-B – Administration Standard for the Commercial Telecommunications Infrastructure
17. TIA/EIA-607-B - 2011 - Commercial Building Grounding and Bonding Requirements for Telecommunications
18. Institute of Electrical and Electronic Engineers (IEEE 802.xLAN)
19. TIA/EIA 942 Data Center Standards
20. Current BICSI Telecommunications Distribution Methods Manual
21. NFPA 70 – National Electrical Code (NEC).
22. BICSI – TDMM, Building Industries Consulting Services International,

Telecommunications Distribution Methods Manual (TDMM).

- C. Governing Codes and Conflicts: If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes, regulations, and manufacturer installation requirements.

1.5 ABBREVIATIONS

- A. The following abbreviations are used in this document:
  - IDF Intermediate Distribution Frame
  - MDF Main Distribution Frame
  - UTP Unshielded Twisted Pair
  - SCS Structured Cabling System
  - RCDD Registered Communications Distribution Designer

1.6 SUBMITTALS

- A. Project Initiation:
  - 1. Within fourteen (14) days of Notice to Proceed, the data network system installer shall furnish the following in a single consolidated submittal:
    - a. Permits: The Contractor shall obtain all required permits and provide copies to the Owner / Architect / Engineer.
    - b. Product Literature: Complete manufacturer's product literature for all cable, patch panels, cross-connect blocks, cable supports, cable labels, outlet devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner / Designer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicated what specific product is to be provided
    - c. Construction Schedule: A time-scaled Construction Schedule, using PERT/CPM, indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
    - d. Testing: Proposed Contractor UTP cable test result forms, fiber optic cable test result forms and a list of instrumentation to be used for systems testing.
    - e. Specification Compliance: A letter shall be provided stating, by section and subsection, that the SCS installer complies with the entire specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been approved by the Owner.
    - f. Each Submittal must have a detailed parts list with quantities.
    - g. Certifications: The contractor shall submit all certifications for approved products and the certifications must contain dates which are valid from the date of proposal and not expirer any sooner than 12 months after substantial completion of the project.
      - 1) BICSI RCDD Certification: This certification must be held by an on-staff, full-time employee of the SCS installer. The holder must be staffed out of the office that is located within 75 miles of the projected.

- 2) Certifications must be obtained by the SCS installer's office that is located within 75 miles of the project and shall be a company certification, not and individual certification.
- 3) Certifications must be held by at least 25% of the, on-site, staff and be made available at the site if requested by the owner, architect, and/or project's technology consultant.
- 4) Fiber Optic Technician Certification: This certification must be held by the on-staff/on-site individual that is supervising the fiber optic installation and performing the fiber optic terminations and testing.

**B. Shop Drawings:**

1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
  - a. Proposed circuit routing and circuit grouping plan prepared by a BICSI certified RCDD (Registered Communications Distribution Designer). The RCDD certification must be current. Identifiable, separate routing shall be shown for both the station cabling and the MDF-to-IDF tie cabling.
  - b. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
    - 1) Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
    - 2) Location of sleeved wall pass-thru
    - 3) Size of sleeve at each location installed
    - 4) Quantity of cable passing through each sleeve
    - 5) Location of drops in each room (quantity or labeling of drops are not required in the submittal plans. Labeling shall be provided in the closeout plans and quantities shall be as per the contract documents, addendums, and issued changes. Each drop shall be labeled for the type of outlet that it is)
    - 6) Conduit routing, size, quantity, and stub-up locations for all floor mounted outlets.
  - c. Drawing Compliance: A letter shall be provided stating that the SCS installer complies with the entire project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been approved by the Owner.
  - d. All subcontractors shall provide submittals to general contractor for normal distribution to Architects, Engineers and the Owner's project managers.

**C. At Substantial Completion:** Provide drawings, to the Owner, to reflect installed cabling with correct labeling and cable routing.

**D. Close-out Procedures:**

1. Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. Close out technology documents shall be separated from all other trade's documents. The close out finals shall include:
  - a. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified.

- The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
- b. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
  - c. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
  - d. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed a list of recommended spare parts.
  - e. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
  - f. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the structure cabling system from the original approved shop drawings. Drawings shall consist of a scaled plan of each building showing the placement of each individual item of the technical cabling system equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
  - g. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. A copy of the As-Built drawings reflecting the final locations of all cabling shall be given to the designated Owner's representative. The as-built drawings shall be prepared using AutoCAD 2012 or later. Provide the Owner with electronic versions of the as-builts on CD media.
  - h. All drawings must reflect final graphic numbering, point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
  - i. A copy of the manufacturer's warranty on the installed system.
  - j. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
  - k. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)
  - l. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Minimum amount of training time shall be at least 4 hours.
  - m. One (1) 30" x 42" laminated floor plan sheets illustrating technology drops and cable designation with final graphic numbering. Contractor shall provide one complete floor plan sheet for each telecommunications room (MDF or IDF)

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Reference Attachment 'B' to this specification, which contains the minimum materials list for this specific project.**

- B. Installation:
1. The cabling shall be installed per requirements of the manufacturer and the Project Documents utilizing materials meeting all applicable TIA/EIA standards. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not explicitly specified below as required for a complete and operational system.
- C. Materials:
1. Materials shall be as listed or shall be approved equivalent products of other manufacturers meeting the intent and quality level of the TIA/EIA specifications.
- D. Testing:
1. All installed cabling shall be tested 100% good after installation by the Contractor. All final test results shall be delivered to owner at completion of project. Refer to closeout requirements.
- E. Ratings:
1. All products shall be new and brought to the job site in the original manufacturer's packaging. Electrical components (including innerduct) shall bear the Underwriter's Laboratories label. All communications cable shall bear flammability testing ratings as follows:  
  
CM Communications Cable  
CMP Plenum Rated Communications Cable  
CMR Riser-Rated Communications Cable
- F. Initial Cable Inspection:
1. The Contractor shall inspect all cable prior to installation to verify that it is identified properly on the reel identification label, that it is of the proper gauge, containing the correct number of pairs, etc. Note any buckling of the jacket that would indicate possible problems. Damaged cable or any other components failing to meet specifications shall not be used in the installation.
- G. Cable Lubricants:
1. Lubricants specifically designed for installing communications cable may be used to reduce pulling tension as necessary when pulling cable into conduit.
  2. Approved Products
    - a. Twisted-pair cable: Dyna-Blue
    - b. American Polywater
- H. Fire Wall Sealant:
1. Any penetration through firewalls (including those in sleeves) will be resealed with an Underwriter Laboratories (UL) approved sealant.
  2. Approved Products
    - a. 3M or
    - b. Pre-approved equal

## 2.2 DATA CLOSET (MDF/IDF) HARDWARE

- A. Equipment Cabinets/Cabinets:
1. Provide and install equipment cabinets and/or cabinets in locations indicated on the attached drawings for the following areas.
    - a. For all MDF/IDF locations:  
Contractor shall provide and install a new floor mounted cabinet/rack system or a wall mounted cabinet where indicated on plans. Refer to floor

plan and enlarged MDF/IDF room layouts for number of cabinets/racks to provide at each location. If an enlarged detail is not available, the contractor shall provide the required number of racks to accommodate 100% of all termination components and an equal amount of owner equipment; as well as (1) spare rack. If an MDF/IDF is located in shared space, the contractor shall provide a floor supported, wall mounted cabinet system with all required doors and side panels to secure the equipment and termination components.

- B. Distribution Cabinet/Cabinet Grounding:
  - 1. All Cabinets and/or Cabinets shall be grounded using stranded #6 AWG insulated copper conductor. Connect to service entrance grounding electrode. Provide all required bonding materials and hardware and bond to building grounding electrode subsystem at building electrical service entrance.
  
- C. Fiber Optic Patch Panels:
  - 1. The enclosures used shall provide termination panels for the specified type of connectors and be of sufficient size and capacity to terminate 110% of the fiber count of the inside of outside fiber optic cables. Patch panels must be 19" cabinet mountable. Provide all termination accessories, fiber patch cords, enclosures and test for a complete fiber optic distribution system.
  - 2. Provide closet connector housing panels, size for 110% of total fiber count to be terminated.
  - 3. ALL fiber strands must be terminated in fiber housing.
  
- D. Patch Panels:
  - 1. All patch cables shall be modular type patch panels to allow individual jacks to be inserted. All patch panels shall be fully populated with Jacks. Provide dust caps for all unused jacks. Furnish units that adhere to the performance requirements TIA/EIA-568A standards.
  - 2. Provide cable support bars at the back of all patch panels to provide additional support at rear of panels. Provide one (1) support bar for each row of 24-ports. Support bars will not be required if the closet design consist of rear horizontal cable management above and below each patch panel.
  
- E. Rack Electrical:
  - 1. A power strip shall be installed vertical at the back of each data relay rack.
  - 2. Provide Uninterruptable Power Supply equipment as designated in the equipment list and/or project drawings.
  - 3. Project electrical contractor to provide and install one electrical receptacle for each UPS installed on the entire project. Coordinate receptacle type and location with the installed product requirements and the technology consultant prior to installation.
  
- F. Cable Management Panels:
  - 1. Provide cable management panels as required for horizontal and vertical cable management. Provide vertical wire management on ends and in between all racks on entire project.
  - 2. Provide Velcro straps for cable dressing in MDF/IDF rooms.
  
- G. MDF/IDF Patch Cables:
  - 1. Cabling Contractor shall provide owner with one (1) patch cable for each data drop on entire project. These cables will provide connectivity from the front of the network patch panels to the network equipment. The patch cables are to be terminated properly with RJ-45 connections on each end with the proper pin-out

- assignments per project configuration.
- 2. All patch cables shall be factory terminated. NO EXCEPTIONS.

### 2.3 CABLE ROUTING/PATHWAY

#### A. Cable Tray:

- 1. Metal cable tray shall be provided to affix to the top of all floor mount cabinets. Cable tray shall be used to brace cabinets to walls and to route cable from walls to cabinets in communication closets.
- 2. Contractor to provide and install all applicable installation accessories.

#### B. Cable Support System:

- 1. All low voltage cabling shall be installed and supported using an approved cable support system installed at 48" intervals unless installed in conduit. Do not exceed manufacturer's recommendation for the quantity of cables supported in an individual support.
- 2. Cable supports shall not connect to any ceiling grid wire or on any support attached to the ceiling grid.
- 3. Cable supports shall not exceed a serviceable height of more than 5', but no closer than 2', above the finished ceiling.
- 4. Cable supports can be attached to vertical walls or the building's structure.
- 5. If attached to the building's structure, 3/8" threaded rod shall be utilized to extend down within the serviceable heights mentioned above. Grid wire hangers will not be accepted.

- C. All cable bundles shall be grouped together using plenum rated Velcro for the entire run above and below the ceilings.

- D. Conduit Bushings shall be installed prior to the installation of any cable. If cable is found to be installed without the bushing the cable will have to be removed and re-installed. No cut bushings will be accepted. If cable damage occurs during any portion of the installation, the cable will be removed and replaced at no cost to the project. This item will be strictly enforced and adhered too.

- E. The projects electrical contractor shall provide and install all metallic conduit and backboxes indicated to be installed on the drawings. It is the SCS installer's responsibility to coordinate all conduit requirements with the electrical contractor to ensure that all conduit sizes and locations are correctly installed. If box locations and conduit sizes are found to vary from the project documents after installation the SCS installer will bare all financial responsibility to ensure these items are installed correctly. The RCDD for the SCS will be responsible for ensuring conduit sizes are sufficient for cable count while maintaining a 40% fill ratio. If there is not electrical contractor on the project, the SCS Installer shall bear responsibility for the provision and installation of all required raceways.

### 2.4 STATION WIRING

#### A. Wire:

- 1. The data and voice wire provided for all outlets shall be four-pair, solid copper conductor, meeting the intent and quality level of the TIA/EIA-568 Commercial Building Wiring Standard.

#### B. Testing:

- 1. The four-pair UTP cable must be UL Performance Level tested. Each 1000-foot spool must be individually tested with test results affixed to the spool. All cable must be provided on new 1000-foot spools. No shorts will be allowed.



- C. Rating:
  - 1. Cable installed in conduit shall be non-plenum rated. Cable not installed in conduit shall be plenum rated if installed in plenum ceiling space, non-plenum rated otherwise.
- D. All cable shall be routed to the center of the room in which it is serving and then route to the outlet location that it is intended for. Provide a 5' service loop in the center of the room and 5' service loop at each workstation outlet properly supported above ceiling. All workstation service loops shall be made in figure eight configurations, no exceptions.
- E. Provide minimum of 10' service loop at all headend locations properly supported above ceiling.
- F. Provide indoor/outdoor, plenum rated category cable at any outdoor data outlet or data outlets served by cabling that travels through subsurface conduit. This applies to station or horizontal cable runs only.

## 2.5 STATION HARDWARE

- A. Information Outlet / Jack Modules:
  - 1. Shall be high quality 8p/8c modular jacks with circuit board construction and IDC style or 110-style wire, T568B terminations. Jacks shall meet EIA/TIA TSB40 recommendations for connecting hardware
  - 2. Shall be standard 8-position, RJ-45 Style, FCC compliant
  - 3. Shall be designed for 4-pair, 100 Ohm balanced UTP Cable
  - 4. Shall terminate 26-22 AWG solid or stranded conductors
  - 5. Shall accept FCC compliant 6 position plugs.
  - 6. Shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
  - 8. Shall meet or exceed transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-C2, Transmission Performance Specifications for 4-Pair 100 Ohm.
  - 9. Shall be UL Listed and CSA certified.
  - 10. Each jack shall have category rating identified on the front face.
- B. Faceplates:
  - 1. Faceplates shall be a minimum of 4-port. 1. Standard faceplates shall be a minimum of 4-port.
  - 2. Wall mounted telephone faceplates shall be 1-port.
  - 3. All faceplates shall be single gang.
  - 4. All blank inserts color shall be coordinated prior to procurement.
- C. Outlet Patch Cables: Cabling Contractor shall provide owner with patch cable for each data drop on entire project. Each cable will be terminated properly with RJ45 connections on each end with appropriate pin-out assignments per project configuration.
  - 1. Cabling Contractor shall provide owner with patch cable for each data drop on entire project. Each cable will be terminated properly with RJ45 connections on each end with appropriate pin-out assignments per project configuration.
  - 2. Patch cords shall be stranded copper, matching the category of the installed cable.
  - 3. All patch cables shall be factory terminated. No exceptions

## 2.6 FIBER OPTIC PRODUCTS

- A. Singlemode:

1. OS2, Single mode fibers, each with a color-coded PVC tight buffer shall have a maximum attenuation of 1.0 dB/km at 1310 nm and 1.0 dB/km at 1550 nm.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Fire Wall Penetrations:
  1. The contractor shall avoid penetration of fire-rated walls and floors wherever possible. Where penetrations are necessary, they shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant. Contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.
- B. Allowable Cable Bend Radius and Pull Tension:
  1. In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation. Refer to the cable manufacturers allowable bend radius and pull tension data for the maximum allowable limits.
- C. Cable Lubricants:
  1. After installation, exposed cable and other surfaces must be cleaned free of lubricant residue.
- D. Pull Strings:

Provide pull strings in all new conduits, including all conduits with cable installed as part of this contract. Pull test is not to exceed 200 pounds. Data and video cables can be pulled together with pull strings.
- E. Conduit Fill:
  1. Conduit fill shall not exceed 40%.
- F. Damage:
  1. The Contractor shall replace or rework cables showing evidence of improper handling including stretches, kinks, short radius bends, over-tightened bindings, loosely twisted and over-twisted pairs at terminals and cable sheath removed too far (over 1-1/2 inches).
  2. The Contractor shall replace any damaged ceiling tiles that are broken during cable installation.
- G. Clean Up:
  1. All clean up activity related to work performed will be the responsibility of the Contractor and must be completed daily before leaving the facility.
- H. Conduit and Back Boxes:
  1. The Contractor shall ensure that the appropriate back boxes and conduits, for the project, are provided as required.
  2. One (1) 1" conduit will be required each outlet that serves one to a maximum six (6) category 6 or a maximum of four (4) category 6A cables. Provide additional conduit for cable counts that exceed this number.
  3. One (1) double gang deep box will be required for each technology outlet. All boxes except Presentation outlets will be required to have a single gang reducer ring.

### 3.2 EQUIPMENT CABINET CONFIGURATION

- A. Equipment Cabinets:
  - 1. Equipment racks shall be assembled and mounted in locations shown on the Drawings and as detailed. Each rack shall be securely mounted to the floor and braced to the wall with cable tray in accordance with the manufacturer's instructions and recommendations. Racks shall be mounted such that the side rails are plumb with vertical cable management panels. Racks to be located such that future expansion can occur without relocating existing racks. Racks shall be grounded in accordance with NEC requirements.
- B. Wire Management Components:
  - 1. Horizontal cable management panels shall be installed directly above and below each patch panel. Vertical cable management panels shall be installed on each side of the cabinet.
- C. Cable Placement:
  - 1. Cable installation in the Wiring Closet must conform to the Project Drawings. All cabling shall be routed so as to avoid interference with any other service or system, operation, or maintenance location. Avoid crossing area horizontally just above or below any riser conduit. Lay and dress cables to allow other cables to enter the conduit/riser without difficulty at a later time by maintaining a working distance from these openings.
- D. Cable Routing:
  - 1. Cable shall be routed as close as possible to the ceiling, floor or corners to ensure that adequate wall or backboard space is available for current and future equipment. All cable runs within the Wiring Closet shall be horizontal or vertical within the constraints of minimum cable bending radii. Minimum bend radius shall be observed. Cables shall not be tie-wrapped to electrical conduit or other equipment.
- E. Installation:
  - 1. All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels. Cable bundles shall not exceed more than 48 cables to patch panel.
- F. Hardware:
  - 1. Provide cabinet and jack panel hardware as required for all data station wiring.

### 3.3 STATION WIRING INSTALLATION

- A. General:
  - 1. Cabling between wiring closet and workstation locations shall be made as individual home runs. No intermediate punch down blocks or splices may be installed or utilized between the wiring closet and the communications outlet at the workstation location.
  - 2. All cable must be handled with care during installation so as not to change performance specifications. Factory twists of each individual pair must be maintained up to the connection points at both ends of the cable. There shall never be more than one and one-half inches of unsheathed UTP cable at either the wiring closet or the workstation termination locations.
  - 3. All cable shall be routed to the center of the room in which it serves before routing to the outlet location and a 5' service loop shall be provide. An addition 5' service loop shall be provided above ceiling at the outlet location. All service loops shall

be figure 8 loops.

B. Exposed Cable:

1. All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed cables and/or cables routing through mechanical rooms, electrical rooms, or restrooms shall be installed inside conduits, unless noted otherwise on the project drawings.
2. Additional exposed cable runs will require Owner approval and will only be allowed when no other options exist.
3. All cable routing through conduits and sleeves shall maintain a 40% maximum conduit fill ratio.

C. Placement:

1. All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair the Owner's efficient use of their full capacity.

D. Cable Routes:

1. All cabling placed in ceiling areas must be in conduit, or Panduit Corp. J-MOD modular cable support with Velcro cable wrap at each location. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment hardware and anchors designed for the structure to which attached and that are suitably sized to carry the weight of the cables to be supported. Do not route cable through webbing of structural steel. Cabling must be supported in dedicated supports intended to support cabling as described in this section. Contractor shall adhere to the manufacturer's suggested fill ratio for each size cable support installed. No support shall have more than 48 cables.
2. Attaching cable to pipes or other mechanical items is not permitted. Communications cable shall be rerouted so as to provide a minimum of 18 inches spacing from light fixtures, sources of heat, power feeder conduits and EMI sources. Cabling shall not be attached to ceiling grid support wires. Cable runs shall be routed down the corridors; parallel or perpendicular to building structure. Multiple cables to be bundled together at and between each cable support installed.
3. Contractor shall be responsible for coordinating with other trades on the project so that the installed cable pathway does not interfere with the installation of other systems to insure that mechanical ducts, pipes, conduits, or any other above ceiling systems are not putting unnecessary stress on any portion of the install SCS.
4. All (48) cable bundles shall be routed directly to the MDF or IDF that serves the area. All bundles shall remain separated for the length of the cable run.
  - a. Provide data outlet for irrigation controllers. Coordinate location with landscape consultant.
  - b. Provide data outlet for time clock appliance in main custodian office.
  - c. Provide OSP or flooded/gel filled CAT 6A cable at any outdoor data outlet or data outlets served by cabling that travels through subsurface conduit. This applies to station or horizontal cable runs only.

### 3.4 STATION HARDWARE

A. Flush Mount Jacks:

1. Flush mount jacks shall be mounted in a faceplate with back box.

B. Placement:

1. Where possible, the communications outlet shall be located so that its centerline

is 18 inches above floor level or 12 inches above permanent bench surfaces. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches.

2. Outlets shall be installed within 3'-0" of power outlets

C. RJ-45 Jack Pin Assignments:

1. Pin connections for data station cable outlets and patch panels shall match EIA/TIA 568 modular jack wiring recommendation T568B.
2. Pin connections at data jack panels shall match pin connections at outlets (straight through wiring)

### 3.5 CABLE TESTING REQUIREMENTS

A. Notification:

1. The Owner and Engineer shall be notified one week prior to any testing so that the testing may be witnessed.

B. Inspection:

1. Before requesting a final inspection, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and timetable for all copper and fiber optic cabling.

C. Procedures:

1. Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor's use of the recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation will be evaluated in the context of each of these factors.
2. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and submittal and approval of full documentation as described above. Tests with the "\*" PASS" (asterisk) will not be acceptable. These circuits must be repaired to meet "PASS".

E. Errors:

1. When errors are found, the source of each shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Re-test results must be provided on Owner approved forms and witnessed by Owner.

F. Twisted Pair Cable Testing:

1. At a minimum, the Contractor shall test all station drop cable pairs from Data Closet termination patch panels to outlet device RJ45 jacks. Products shall be tested for compliance with ANSI/TIA/EIA 568A and ISO/IES 11801. Test equipment used shall meet TIA/EIA TSB-67, Level II accuracy. Further, the contractor shall have a copy of TSB-67 in their possession and be familiar with its contents.
2. Each wire/pair shall be tested at both ends for the following:
  - a. Wire map (pin to pin connectivity)
  - b. Length (in feet)
  - c. Attenuation
  - d. Near end cross talk (NEXT)
  - e. Power Sum
3. Test equipment shall provide an electronic and printed record of these tests.
4. Test results for each four-pair UTP cable must be submitted with identification to match labels on all patch panel ports and RJ45 jacks and must match as-builts

associated with that cable.

- G. Fiber Optic Cable Testing:
1. Testing device for fiber optic cables shall be a high quality OTDR (Optical Time-Domain Reflectometer) equipped with a printer. The printed data shall show, in addition to any summary information, the complete test t0.and all relevant scale settings. The OTDR must have the capability to take measurements from bare fiber strands as well as SC connector terminations.
  2. All fiber optic cable shall be tested on the reel before installation to ensure that it meets the specifications outlined herein.
  3. After installation the Contractor shall test each fiber strand in accordance the EIA 455-171 Method D procedures (bi-directional testing) at both 850nm and 1300nm for multimode or 1310nm and 1550nm for single mode. A form shall be completed for each cable showing data recorded for each strand including length, total segment (end-to-end) loss (dB) and connector losses (dB) at each end. In addition, the printed data strip for each strand shall be attached to the form. Patch cables shall also be tested.
  4. Acceptable fiber optic connector loss shall not exceed .75dB per mated pair. The Contractor is responsible for obtaining minimum loss in fiber connections and polishing per manufacturer specifications.
  5. Singlemode:
    - a. Singlemode fibers shall have a maximum attenuation of 1.0 dB/km at 1310 nm and 1.0 dB/km at 1550 nm.
  6. Multimode:
    - a. 50/125um micron multimode fibers shall have a maximum attenuation of 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm. Minimum bandwidth shall be 2000 MHz/km at 850 nm and 500 MHz/km at 1300 nm.

### 3.6 INSPECTION

- A. Conformance to the installation practices covered above is to be verified when completed. In some cases, the Owner/Designer may inspect before acceptance.
1. Written Test Report:
    - a. Complete test results, including actual values associated with tests.
    - b. Show all certifications for telecommunications wiring systems.
    - c. Include cable maps showing each cable route and keyed to cable labels. Provide owner with complete floor plans identifying outlet location and cable routing drawing in AutoCAD format. Provide electronic copy of drawings to owner in AutoCAD version 2012 or greater.
    - d. Documentation of outlet, cable and cabinet labeling system.
- B. After performing all tests, tabulate results and bind together in format acceptable to Owner. Installer shall provide written certification in the test report that telecommunications cable is properly installed, and test results certify system to all specified standards.

**END OF SECTION**

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**SECTION 27 30 00**

**IP BASED DISTRICT WIDE INTEGRATED COMMUNICATIONS SYSTEM**

**PART 1 GENERAL**

1.01 SCOPE

- A. The contractor shall provide a new IP Based Integrated Communication System to encompass the scope of work indicated in plans for this project as part of an extension of an existing Valcom IP6000 system on campus.
- B. **By submission of a Prime Bid for this project, the Prime Bidder assumes complete and total responsibility for himself and his subcontractors' compliance with this specification in its entirety. If found to be not in compliance with any part of this specification, the Prime Bidder shall bear any burden, financial or otherwise, required to complete the work of this specification to the total satisfaction of Irvine Unified School District.**
  - 1. The installation of the new IP Based District Wide Integrated Communication System Intercommunication and Program System shall be performed and all equipment shall be installed Certified provider of the equipment cpscified herein.
    - a) The Certified Provider shall furnish all labor, materials, appliances, licenses, tools, equipment, facilities, transportation and services necessary for and incidental to the performance of all operations in connection with furnishing, delivery and installation of all equipment, cabling, programming, configuration, testing and training required by this Section, complete as indicated in the applicable Contract Drawings and/or specified herein.
- C. The IP Based Integrated Communication System installed on this project shall be compatible with the District Wide IP Integrated Communication Network currently and/or being installed on campuses in the District.
  - 1. All Data Networking, cabling and connectors shall be provided by the data networking contractor and shall comply with the requirements of that specification section.
  - 2. All Data Networking electronics shall be provided by the District Information Technology Department.
    - a) Ports and IP Addresses, as required, shall be provided by the District Information Technology Department.
  - 3. All Speakers, Clocks, Licenses, Backboxes, Gateways, Scrolling Message Devices and Programming shall be provided by this contractor and shall comply under the requirements of this specification section.
    - a) Contractor shall provide Mac Addresses, with specific location descriptions, to the District Information Technology Department.
- D. This specification provides the requirements for the installation, programming and testing of all hardware devices provided under this system expansion.
- E. Any material and/or equipment necessary for the proper operation of the system expansion, which is not specified or described herein, shall be deemed part of this Specification.
- F. The Communication system shall provide distribution of intercom, overhead paging, emergency paging and alerts, time and date, text to speech class change time tones, emergency tones, CAP sourced alerts, program material and on-board emergency messaging including USGS licensed Earthquake Early Warning Systems capabilities.
- G. IP6000 Communication System shall be an extension of the existing IP6000 intercom system and shall distribute intercom, overhead paging, emergency paging, class change time tones, emergency tones and program material over all speakers in all buildings, including portable buildings and structures, not being remodeled. Provide new IP speakers and/or clock speakers, cabling and devices at existing buildings (interior and exterior) for a complete, and site wide system installation

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- H. The IP6000 Communication System shall be interfaced with the Facilities' telephone system to ensure full access to the IP6000 Communication System speakers. Coordinate all work with the Facilities' IT Department.
- I. The IP6000 Communication System shall be programmed to meet the Facilities' requirements. The contractor shall meet with the Facilities' maintenance department and obtain programming criteria prior to programming the system. The system shall be tested in the presence of the IOR and Facilities' maintenance department staff prior to completion to ensure compliance with the Facilities' criteria and the contractor shall make required modifications to the system as required to satisfy the School District Facilities' requirements.

1.02 QUALIFICATIONS

A. Equipment

- 1. This specification is based on the equipment of manufacturer(s) who have been approved by the La Canada Unified School District Information Technology Department.
- 2. The equipment manufacturer shall be a United States manufacturer, who has been regularly engaged in the manufacture of Integrated Communications Equipment for at least twenty-five (25) years.
- 3. **The compatible hardware devices for expansion of the IP Based District Wide Integrated Communication System shall be the product of Valcom. No substitutions shall be approved.**
- 4. It is the Contractor's responsibility to meet the entire intent of these specifications. Deviations from the specified items shall be at the risk of the Contractor until the date of final acceptance by the Architect of Record, Engineer of Record and the Owner's representative. **All costs for removal, relocation or replacement of a substituted item shall be at the risk of the Prime Contractor.**
- 5. All equipment shall conform to currently adopted applicable codes and ordinances.

B. System Supplier/Installer

- 1. **All equipment for this expansion shall be furnished and installed by a Certified Provider of the Valcom IP6000 Integrated Communications System who's technicians have been trained and certified by the Manufacturer in the proper installation, programming, testing, service and maintenance of the system specified herein.**
- 2. Subsequent to a successful bid and upon request of the Owner the System Supplier/Installer shall submit a qualification documentation package which shall include the following:
  - a) Evidence of current status as a Certified Provider of the Valcom IP6000 IP Integrated Communications System.
  - b) Certificates issued by Valcom for System Supplier/Installer employees trained on this system.
  - c) Evidence of current State of California Contractor's License, C-10 and C-7.
  - d) Upon request, the System Supplier/Installer shall show satisfactory evidence, that he maintains a fully equipped service organization capable of furnishing adequate inspection, service and maintenance of the system.
  - e) The System Supplier/Installer shall maintain at his facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.
  - f) The System Supplier/Installer shall provide proof that they maintain a complete service and maintenance center within 50 miles of the project address. A complete service center shall include replacement parts in



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stock in the quantities deemed sufficient by the owner or its representatives. -

- g) Contractor shall be an authorized designer/integrator of the supplied equipment with full warranty privileges with C10 and C7 licenses in good standing with CSLB.

1.03 RELATED SPECIFICATIONS

- A. The conditions of the General Contract (General, Supplementary, and other Conditions) and the Division 1 - General Requirements specifications are hereby made a part of this Section.

- 1. Section 27 10 00

1.04 RELATED WORK BY OTHERS

- A. Reference Part 3, sub-section 3.01 of this specification.

1.05 RELATED DOCUMENTS

- A. In the event of a conflict between this specification and the construction drawings this specification shall take precedence.

1.06 APPLICABLE CODES & STANDARDS

- A. The Intercommunication and Program System shall comply with the currently adopted versions of the following:
  - 1. Building Standards Administrative Code, Part 1, Title 24, California Code of Regulations
  - 2. California Building Code (CBC) Part 2, Title 24, California Code of Regulations (International Building Code, with California Amendments)
  - 3. California Electrical Code (CEC) Part 3, Title 24, California Code of Regulations (National Electrical Code with California Amendments)
- B. ADA - Americans with Disabilities Act
- C. CAC – California Administrative Code, Title 24

1.07 SUBSTITUTIONS

- A. **The system installed under this project shall become an integral component in the District Wide IP Integrated Communications Network. No equipment substitutions shall be accepted.**

1.08 SUBMITTALS

- A. Within thirty-five (35) calendar days after the date of the award of the contract, the Contractor shall submit to the Architect for review, eight (8) copies of a complete Submittal Package. The Submittal Package shall consist of the following sections, with each section separated with index tabs.
  - 1. Title Page
    - a) Project Title
    - b) Owner's name
    - c) Architect's name
    - d) Electrical Engineer's name
    - e) Contractor's name
  - 2. Index of Submittal Contents
    - a) Each Section of the Submittal Package shall be numbered chronologically and shall be summarized in the Index.
  - 3. Certifications
    - a) Index of Certification Section Contents
    - b) Valid State of California Contractors License
      - 1) License requirement for this installation shall be C-10 and C-7.
    - c) Manufacturer's Certifications
      - 1) Valcom Certified Provider
      - 2) Trained Technician
  - 4. Project List
    - a) A substantial list (minimum of 20) of completed projects equal in scope to that specified herein.
      - 1) Contact information shall be made available upon request.

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5. Product Data
  - a) Index of Equipment Data Sheets
  - b) Manufacturer's Data Sheets including cable types
  - c) Applicable Listings and Approvals
6. Shop Drawings
  - a) Layout drawing of the communication system and all components.
  - b) Include control equipment layout of major components and positions within equipment rack.
  - c) Block diagrams showing components and relative connections.
  - d) Signed and sealed by a qualified professional engineer or an RCDD.
  - e) Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components and locations of each field connection.
  - f) Station arrangement details.
  - g) Signal and control wiring diagrams including single line diagram showing interconnections of components and cabling diagram showing cable routing.
  - h) Drawings shall include items of coordination of other trades, including but not limited to lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels and special moldings.

1.09 RESPONSIBILITIES

- A. Contract documents are detailed only to the extent required to show design intent. It shall be understood and agreed upon by the Contractor that all work described herein shall be complete in every detail.
- B. Furnish additional items not mentioned herein to meet requirements as specified without claim for additional payments. Items may include hardware, rack panels, 66 blocks, etc., and other devices that are required for installation. Furnish additional items not mentioned herein to meet requirements as specified without claim for additional payments. Items may include hardware, rack panels, 66 blocks, etc., and other devices that are required for installation.
- C. Furnish additional items not mentioned herein to meet requirements as specified without claim for additional payments. Items may include hardware, rack panels, 66 blocks, etc., and other devices that are required for installation.
- D. Labor furnished shall be manufacturer trained and experienced in telecommunication and networked systems.
- E. All equipment unless specified shall be new and free from defects and the best craftsmanship in its class.
- F. Perform initial and final programming of system and audio level adjustments.
- G. Provide information on system requirements to any contractor responsible for supplying related materials for this system.

**PART 2– PRODUCTS**

- 2.01 COMMUNICATION SYSTEM – System shall provide at least the following functions and features.
- A. Direct dialed, hands-free, two-way communication from all administrative telephones to room locations equipped with a talkback speaker.
  - B. Microprocessor based PoE system capable of handling unlimited end-points. An end-point is defined as a device with an IP address. The system IP speakers must be SIP compliant.
  - C. System shall be VoIP system compatible with 45 ohm 2-way speakers, 25V 2-way speakers, self-amplified one-way speakers and VoIP speakers. The system should also have 1, 2 and 4 zone one-way gateways for common area announcements.
  - D. System shall interface with any SIP capable VoIP telephone system, analog telephone system, or single line telephone, thus allowing the School District(s) to upgrade or replace their telephone system without suffering a requirement to replace,

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- or lose any feature of, their internal communications (intercom) system. Any system that limits system features based upon any selected telephone system, and/or is proprietary to one or only a few telephone system shall not be acceptable.
- E. System shall be capable of converting and loading WAV files used for bells, announcements or music.
  - F. System shall be capable of initiating emergency notifications by internet browser from anywhere on the network.
  - G. System shall be capable of increasing volume by event. An event is defined as any WAV file or tone.
  - H. System shall be capable of downloading a graph (site, building, etc.) and arranging icons on it to play emergency announcements, back to School District announcements, message from the Superintendent, etc.; any WAV file.
  - I. System shall automatically sound a tone over an loudspeaker connected for two-way communication to alert the room teacher that this two-way call has been established. This is intended to prevent unauthorized monitoring. The privacy tone must repeat every 15 (fifteen) seconds.
  - J. System shall be capable of distribution of emergency or general announcement(s) by Administration functions or from any authorized telephone to all areas furnished with a loudspeaker. Emergency announcements shall have the highest system priority.
  - K. System shall have native CAP and USGS licensed Earthquake Early Warning Systems.
  - L. Room speakers shall be software assignable to an unlimited number of audio groups.
  - M. System shall be capable of providing and IP speaker clock combined with an analog clock face.
  - N. Provide the ability to define and archive unlimited time tone schedules with unlimited events per schedule. Each scheduled event shall be capable of controlling any internal tone, user selected custom WAV files, audio from any auxiliary source or up to 40 relays for building control. Each scheduled audio even shall be distributable to any of the audio groups. The system shall feature the ability to automatically initiate unlimited schedules per day, based upon the day of the week or calendar dates up to one year in advance. The system shall feature the ability to operate 25 or more schedules simultaneously. Schedule administration, modification and creation functions must be available through an internet browser. Systems that do not allow the School District to manage their own schedules with an internet browser do not offer calendar-based scheduling up to one year in advance or require separate page and time groups shall not be acceptable.
  - O. Provide one to eleven digit numbering plan, thus allowing the room speaker and the room telephone to be the same architectural number.
  - P. Programmable features shall be stored in non-volatile memory and shall not be lost due to power failures.
  - Q. Room initiated intercom calls must be able to be assigned to ring at specific administrative ports. These administrative ports shall have the flexibility to be forwarded to other administrative ports should a call go unanswered or should the assigned administrative port be busy.
  - R. System functionality must include the capability to manually activate an unlimited amount of chained events via browser based device, push buttons, contact closure, or dial up tones from any administrative telephone. These events shall be customizable with respect to volume levels, cadence, priority, type and duration. Browser access must only be accessible by authorized users.
  - S. The system must be capable of providing an unlimited amount of ports to be connected to the telephone system via SIP for FXS Port integration from the intercom system. These ports shall provide built-in Enhanced Caller Line Identification which will visually announce the name of the teacher or location, the architectural room number. Systems that require integration to a specific telephone system or systems in order to offer this feature, or any system feature, shall not be acceptable.

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- T. The system shall have the ability to control all system relays. Relays shall be controlled through the browser, DTMF controlled, automatically cycle at a programmed time of day, or follow time schedule events. All relays must be software programmable with the flexibility to change as required.
- U. The system shall provide at least three simultaneously operating, non-restrictive program distribution channels. The system administration shall be browser based allowing simple and easy changes.
- V. The system shall have the ability to store up to 25,000 seconds of WAV files directly onto the Application Server and shall not be lost due to power outage.
- W. The WAV files shall be capable of being activated via any computer on the LAN/Wan, telephone and/or telephone system, and push buttons.
- X. The WAV files shall be programmable as to what level of priority they can be broadcast. They shall be programmable as to override any class change tones, normal all call, music, and intercom in the event of an emergency.
- Y. The WAV files shall also have the ability to be broadcast into any and all of the audio groups.
- Z. The WAV files shall have the ability to be broadcast via a schedule for any day of the week r time of the day. They shall also have the ability to be broadcast for any duration of time and repeat number of plays with the ability to select how long the duration is between each repeated broadcast.
- AA. The WAV files shall be able to be broadcast via a pushbutton. When this pushbutton is activated, it shall be programmable to select which WAV file is broadcast, the priority level, where it is broadcast and how many times it shall play.
- BB. The WAV files shall also have the ability to be a part of the class change tones within the system. These files shall be able to replace any tone within the class change schedules as to offer the flexibility of customizable tones and/or phrases in this class change mode.
- CC. The system shall have the ability to, at a minimum, deliver text messages to LED signage, computer screen pops or to Chrome books.

2.02 SYSTEM COMPONENTS

- A. Manufacturer: Valcom, Inc Roanoke VA USD
  - 1. IP6000 Communication System (Existing head end on campus located in new 2-story building)
 

Contractor shall provide a CAP Compliant Applications server #VE6030-1. The server shall provide automated emergency messaging, USGS licensed Earthquake Early Warning System, event scheduling and clock control capability. It shall allow distribution of WAV formatted audio out to 25 simultaneous groups of speakers. The simple browser-based interface facilitates easily accessible manipulation of custom audio files for use as class change tones or emergency notification alerts. The VE6030-1 features text-to-speech conversion and provides on demand access of pre-loaded audio files via web browser, dial code or contact closure. Schedules may be automated based upon day of the week, calendar date up to one year in advance, or may be manually controlled.
  - 2. Contractor shall seamlessly bridge new Valco IP6000 system to existing school PA system and any VoIP/SIP or legacy phone system via SIP, FXO or Loop Start Trunk. Contractor shall provide all equipment and programming along with a working system for paging, intercom and class passing bell schedules. Contractor shall remove existing Bogen Multicomm system and bridge all existing field speakers utilizing amplifier (existing, Bogen amplifier if possible) connected into new Valcom VEIP6K-1 audio gateway to create a single zone, one way paging extension for existing field wiring and devices (speakers) into all existing buildings on campus.
- B. Low Voltage I/O Control Relay - #VE8048AR IP Input/Output module allows operation of eight (8) contact closures which are software programmable as either form A or form B. Eight (8) contact closure activated inputs provide for various

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programmable relay functions and allows initiation of VE6030-1 server events over an IP-based LAN/WAN.

- C. Indoor IP Speaker with integrated Digital Clock
  - 1. The Standard IP Speaker with integrated Digital Clock for talkback applications shall be Valcom VL520BK-F
  - 2. The Large Area IP Speaker with integrated Digital Clock for talkback applications shall be Valcom VL550BK-F
- D. Indoor Ceiling IP Speaker
  - 1. The IP Speaker for non-talkback applications shall be Valcom VIP-402A.
- E. Interior and Exterior speakers shall be contractor provided and installed
  - 1. Stealth Horns IP 1 Way Indoor/Outdoor #V9831AL
  - 2. 8" "hard lid" ceiling speaker #V1020
  - 3. Bridge and Backbox combo for 8" #V9916M
  - 4. 2x2 lay-in ceiling speaker #VE9022A-2
  - 5. T-Bar for drop in ceiling speaker #V-TBAR
- F. IP Gateways for Analog Speaker Interface
  - 1. The 12- port Talkback Gateway shall be Valcom VE1225.
- G. SIP IP Intercom Controller
  - 1. Provide (1) SIP IP Intercom Controller Valcom #VE8090R at the MDF and interface to the SIP telephone server and audio gateway (#VE8004BR). Contractor shall provide an emergency backup phone (#VEADP4) connected to one (1) of the two FXS ports.
- H. Touchscreen Console
  - 1. The Interactive Touchscreen Console shall be Valcom VE8092 equipped with USGS licensed Earthquake Early Warning system capable of alerting all speakers and digital signage.
    - a) Provide a minimum of three (3) for Elementary and Middle Schools.
    - b) Provide a minimum of six (6) for High Schools.
- I. Large IP Scrolling Message Display
  - 1. Not used.
- J. System Cable
  - 1. **All system data network cable and connectors shall meet the La Canada Unified School District Standards for Data Networking and shall be provided by the Data Networking Contractor and shall comply with the requirements of that specification section.**
- K. Network Equipment/Switches -
 

Network equipment such as switches, routers, servers, etc., shall be provided by District. The contractor shall acquire and comply with the latest IP6000 network requirements as provided by Valcom.

### PART 3- EXECUTION

#### 3.01 DIVISION OF WORK

- A. While all work included under this specification is the complete responsibility of the Electrical Contractor, the division of actual work listed following shall occur.
  - 1. Equipment specific backboxes provided by the system manufacturer shall be provided by System Supplier/Installer and installed by the Electrical Contractor.
  - 2. The balance of the system, including installation of all other manufacturer's equipment and connection to the data network system, shall be performed by the System Supplier/Installer.

#### 3.02 INSTALLATION

- A. All work shall be completed in strict accordance with all applicable codes and ordinances, by a member in good standing of the AtlasIED Certified Integrator Program who has achieved Platinum Status.
- B. Cable/Wire
  - 1. All cable/wire for the system specified herein shall be provided by the data contractor.

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- C. Wiring Method: Install wiring in raceways except within consoles, cabinets, desks and counters and except in accessible ceiling spaces and in gypsum-board partitions where cable wiring method may be used. Use plenum cable in environmental air spaces, including plenum ceilings. Conceal cables and raceways except in unfinished spaces.
  - D. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours. Secure and support cables by straps or similar fittings designed and installed to avoid damage to cables. Secure cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes or fittings.
  - E. Wiring and enclosures: Bundle, lace and train conductors to terminal points with no excess. Use lacing bars in cabinets.
  - F. Control Circuit Wiring: Install number and size of conductors as recommended by system manufacturer for control functions indicated.
  - G. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs as specified by BICSI TDMM 13 Edition.
  - H. Match input and output impedances and signal levels a signal interfaces. Provide matching networks where required.
  - I. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements for weatherproof rating.
- 3.03 SYSTEM START-UP/PROGRAMMING
- A. All start-up programming and system commissioning shall be performed by a manufacturer's trained and certified technician currently employed by the System Supplier/Installer.
  - B. Engage a factory-authorized service representative to perform startup service and initial system programming. Factory representative shall be on site to assist in system programming and commissioning.
  - C. Fully brief owner on available programming options. Record Owner's decisions and set up initial system program. Prepare a written record of decisions, implementation methodology and final results.
  - D. Verify electrical/low voltage wiring installation complies with manufacturer's submittal and installation requirements.
  - E. Perform the following field tests and inspections:
    - 1. Schedule tests with at least seven (7) days advance notice of test performance spaces.
    - 2. After installing School District intercom and program equipment and after electrical circuitry has been energized, test for compliance with requirements spaces.
      - a) Operational Test: Test originating station-to-station, all-call and page messages at each intercom station. Verify roper routing and volume levels and that system is free of noise and distortion. Test each available message path from each station on system.
  - F. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. system.
  - G. Inspection: Verify the server and devices are running the latest software revisions. system.
  - H. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels and for any initial troubleshooting.
- 3.04 ACCEPTANCE TESTING
- A. The system installer shall, in the presence of the Inspector of Record (IOR), perform testing to the satisfaction of the IOR.
- 3.05 IN SERVICE TRAINING

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- A. The Contractor shall instruct personnel designated by the District/Owner in the proper use, basic care and maintenance of the system beyond the warranty period.  
Contractor shall provide up to eight hours of in-service training with this system.
- 3.06 RECORD DRAWINGS AND CLOSE-OUT DOCUMENTATION
  - A. System supplier/installer shall periodically update the General Contractor's master set of record drawings kept on site.
  - B. Contractor shall provide the following at close-out.
    - 1. One electronic (PDF) copy of system record drawings.
    - 2. Three (3) wet signed copies of equipment warranty.
- 3.07 WARRANTY
  - A. The System Supplier/Installer shall warrant the equipment and/or materials to be new and free from defects in material and workmanship, and will, within one (1) year from the date of final acceptance, repair or replace any equipment and/or materials found to be defective. This warranty shall not apply to any equipment or materials that have been subject to misuse, abuse, negligence or modification by owner or contractors other than the original installer that provided this warranty.

**End of Section**

SECTION 28 10 00  
ELECTRONIC ACCESS CONTROL SYSTEM

PART 1 – GENERAL

1.01 WORK INCLUDED

- A. The contractor shall furnish and install a complete microprocessor based access control system as specified herein. The system shall include, but not be limited to, all control equipment, power supplies, power circuits, signal initiating and signaling devices, door hardware, conduit, wire, fittings, labor and all other accessories required to provide a fully functioning system.

1.02 CODES AND STANDARDS

The system shall comply with the applicable Codes and Standards as follows:

- A. National Fire Protection Association Standards:
  - 01. NFPA 70 National Electric Code
  - 02. NFPA 72 National Fire Alarm Code
  - 03. NFPA 101 Life Safety Code
- B. Local & State Building Codes
- C. Requirements of Local Authorities having Jurisdiction
- D. Underwriters Laboratory Requirements and Listings for use in Security Alarm Systems.
- E. Requirements of American Disabilities Act (Public law 101-336).
- F. State Fire Marshall.

1.03 RELATED WORK

- A. Division 08- Door Hardware
- B. Section 28 20 00 – Video Surveillance

1.04 DEFINITIONS

- A. ACS – Access Control System
- B. CSA – Client Software Application
- C. DGM – Dynamic Graphical Maps
- D. ALPR – License Plate Recognition
- E. SDK – Software Development Kit
- F. SMA – Software Maintenance Agreement
- G. SSM – Server Software Module
- H. UI – User Interface
- I. USP – Unified Security Platform



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- J. USW – Unified Web Client
- K. VMS – Video Management System
- L. DVS – Digital Video Server

#### 1.05 QUALITY ASSURANCE

- A. Contractor Qualifications:
  - 01. The installing contractor shall be the authorized representative of the access control system manufacturer to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the security alarm manufacturer's product for at least two years.
  - 02. The installing contractor shall be licensed by the State as a security services contractor to design, sell, install, and service security alarm systems.
  - 03. The installing contractor shall provide 24 hours, 365 days per year emergency service with factory trained service technicians.
  - 04. The installing contractor shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security alarm systems for at least ten (10) years.
- B. The system programmer shall have attended manufacturer training and obtained certification in provided system.
- C. Optionally, the system programmer shall have attended manufacturer training and obtained certification in provided system.
- D. All Contractors shall submit to the Owner prior to starting any work the factory training certificates for all personnel that will be working on the access control system. No person is allowed to work on the system without proper manufacturer's certification.

#### 1.06 SUBMITTALS

- A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
  - 01. Control panel wiring and interconnection schematics.
  - 02. Complete point to point wiring diagrams.
  - 03. Riser diagrams.
  - 04. Complete floor plan drawings locating all system devices.
  - 05. Factory data sheets on each piece of equipment proposed.
  - 06. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
  - 07. Complete system bill of material.
  - 08. Line by line specification review stating compliance or deviation.
- B. All submittal data will be in bound form with Contractor's name, supplier's name, project name, and state security license number adequately identified.

### PART 2 – PRODUCTS

## 2.01 ACCEPTABLE MANUFACTURERS

- A. Head-End/Software
  - 01. VerKada
  
- B. Controllers
  - 01. VerKada
  
- C. Card Readers
  - 01. VerKada
  
- D. Wiring
  - 01. Belden
  - 02. Approved Equal

## 2.02 PERFORMANCE REQUIREMENTS

- A. Controllers:
  - 01. System Controller:
    - a. Up to 64-Doors
    - b. 12-24VDC
    - c. Minimum quantity of one (1) RS-485 output
  - 02. Door Controller
    - a. Minimum quantity of two (2) reader outputs
    - b. 12-24VDC
    - c. RS-485 communication
  
- B. Card Readers
  - 01. MutliClass reader
  - 02. 50/75mA @ 12VDC
  - 03. Wiegand interface
  - 04. Wall mounted: RP40
  - 05. Mullion mounted: RP10
  - 06. Unit Lock Access: Control Z-Wave System
    - a. Must be able to integrate within Genetec.
  - 06. Cards: 125KHz prox technology/KeyFobs
  
- C. Wiring
  - 01. Plenum rated
  - 02. Minimum of 18 AWG

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. The contractor shall have furnished and installed a complete microprocessor based access control system as specified herein. The system shall include, but not be limited to, all control equipment, power supplies, power circuits, signal initiating and signaling devices, door hardware, conduit, wire, fittings, labor and all other accessories required to provide a

### 3.02 HARDWARE INSTALLATION

- A. General

01. Provide mock-up of a typical entry door, complete with conduit, outlet boxes, cables and access control devices prior to installation.
02. All 120V Power shall be furnished as specified in Division 26. Coordinate with Division 26.
03. All security conduit as required for a complete installation of this system shall be provided as specified in Division 26.
04. Coordination with the Division 26 is the responsibility of the Security Contractor to ensure all conduit is in place for a complete installation.
05. All systems shall be connected to a dedicated circuit and on an emergency power source if available.
06. All door hardware to be coordinated with Division 08, reference Division 08 for hardware requirements.

B. Wiring/Conduit

01. All wiring shall be in accordance with the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
02. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.
03. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.
04. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
05. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
06. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
07. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors trans versing the respective box as well as the number of terminations required.
08. All plenum wiring is to be installed parallel and perpendicular to the building structure. Install wiring tight up against structure for protection. Cable shall be bundled on a maximum of 2'-6" and secured to the structure at a maximum of 5' on center. Bundling and support shall be with plenum rated cable ties.
09. Contractor is required to provide all mapping and software configuration required to operate system as per manufacturer's recommendations.
10. All wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated j-hook style cable support system for the entire run of each cable. Including, but not limited to service loops.
11. The cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the support hook to the treaded rod.
12. Power wiring may all be run from central location for door hardware.

C. System

01. Furnish and install one (1) card reader for each location shown on drawings.
02. Provide and install a centralized architecture, with each access panel being installed on the wall in the each of the (2) new Building IDF closets. Running each half of the building to the closets on the plan north and plan south. Centralized power supply for locking hardware is preferred. Provide one CloudLink device per closet where an access panel is being installed, for network tie-in.

03. Furnish and install one (1) unit lock, for each unit location shown on drawings.
04. Furnish and install quantity of Multi-Device Interface Panel necessary to add all door position switches into system.
05. Provide an additional four (4) hours per site of programming, coordinate final programming with Owner's personnel.

### 3.03 TESTING

- A. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner, Engineer, Electrical Contractor and performed by the equipment supplier. Final test report shall be received and acknowledged by the Owner prior to substantial completion.
- B. Provide instruction as to proper use and operation of system, for the Owner's designated personnel.

### 3.04 DEPLOYMENT SERVICES AND SYSTEM COMMISSIONING

- A. General Requirements
  01. The contractor shall engage the services of the USP vendor to assist in the management of the deployment of the USP at the end-user site on the project.
  02. The USP vendor services shall include Deployment Management and System Configuration and Commissioning.
- B. Deployment Management Service
  01. The Deployment Management service from the vendor shall include a Project Manager acting as the single point of contact for all communications between the contractor and the vendor organization and who will be responsible for:
    - a. Conducting a Risk Assessment of the impact of potential risk factors on the operation of the vendor's USP.
    - b. Providing a project plan for the deployment of the vendor's USP.
    - c. Managing the development and deployment of the custom solution components that will be integrated into the vendor's USP (if applicable).
    - d. Providing a scope of work detailing the services to be provided by the vendor to assist in the deployment of the vendor's USP.
    - e. Coordinating and scheduling the vendor field services with the contractor to assist with the deployment of the vendor's USP.
    - f. Providing regular project status updates to the contractor regarding the development of custom solutions (if applicable) and the deployment of the vendor's USP.
- C. System Configuration and Commissioning Service
  01. The System Configuration and Commissioning service from the vendor shall include a Field Engineer who will be responsible for:
    - a. Assisting the contractor's or/subcontractor's onsite/remote technicians with the configuration and commissioning of the vendor's USP at the client site.
    - b. Conducting a test of the USP following the deployment of the system using real-world operator scenarios to ensure optimal system performance.
    - c. Providing the contractor with a Service Report detailing the tasks completed during the deployment of the USP at the client site, as well as any recommendations for improving the performance of the USP that must be implemented by the contractor.
    - d. Providing a knowledge transfer of the vendor's USP to the contractor following the deployment of the USP at the client site.

3.05 WARRANTY

- A. Contractor shall provide minimum of one (1) year warranty of workmanship and product. Must support (24) hour turn time to fix and/or replace any system issues or hardware
- B. The product shall perform in all material respects in accordance with the accompanying user manual, and the media on which the Software Product resides will be free from defects in materials and workmanship under normal use. Software defects are covered through Service Releases and Cumulative Updates which are available for a period of 1 year from the date of substantial completion

END OF SECTION

**Division 28 13 00**  
**SECURITY MANAGEMENT SYSTEM**

**PART 1 GENERAL**

**1.01 Summary**

- A. The Security Management System (SMS) shall be the key central component for managing physical security. The system shall provide a variety of integrated functions including access control, alarm monitoring, intrusion detection, visitor management and video.

This project is an addition to an existing Lenel OnGuard installation and successful Security Contractor will ensure their bid includes any additional fees, licensing, or similar and are included in their bid.

Coordination of work with all necessary trades is a requirement to ensure work performed by other trades is congruent with the goals of the District in adding security to its facilities.

It is incumbent on the successful Security Contractor in this section to provide a fully functional and working system regardless if products or materials are not called out specifically in this document. Any change order will be honored only upon the request of the District.

**1.02 Related Requirements**

**1.03 References**

A. Abbreviations

1. ACS: Access Control System
2. ADRC: Advanced Dual Reader Controller
3. AES: Advanced Electronic Encryption
4. API: Application Programming Interface
5. DAS: Direct Attached Storage
6. DHCP: Dynamic Host Configuration Protocol
7. DPS: Door Position Sensor
8. DRI: Dual Reader Interface
9. FASC: Federal Agency Smart Credential
10. FASC-N: Federal Agency Smart Credential Number
11. FICAM: Federal Identity, Credential, Access Management
12. FIPS: Federal Information Processing Standard
13. ICM: Input Control Module
14. IP: Internet Protocol
6. ISC: Intelligent System Controller

16. IDRC: Intelligent Dual Reader Controller
  17. ISDC: Intelligent Single Door Controller
  18. LAN: Local Area Network
  19. LDAP: Lightweight Directory Access Protocol
  20. NAS: Network Attached Storage
  21. NFC: Near Field Communications
  22. NVR: Network Video Recorder
  23. OCM: Output Control Module
  24. ODBC: Open Database Connectivity
  25. OPC: OLE for Process Control
  26. OSDP: Open Supervised Device Protocol
  27. PACS: Physical Access Control System
  28. PIV: Personal Identity Verification
  29. POE: Power-Over-Ethernet
  30. RAM: Random Access Memory
  31. REST: Representational State Transfer
  32. REX: Request to Exit
  33. RFID: Radio Frequency Identification
  34. RIM: Reader Interface Module
  35. SAN: Storage Area Network
  36. SIA: Security Industry Association
  37. SMS: Security Management System
  38. SQL: Structured Query Language
  39. SRI: Single Reader Interface
  40. SSL: Secure Sockets Layer
  41. TCP: Transport Control Protocol
  42. TDE: Transparent Data Encryption
  43. TWIC: Transportation Worker Identity Card
  44. UPS: Uninterruptible Power Supply
  45. VMS: Video Management System
- B. Definitions
1. Alarm aggregation: A mechanism of combining several alarms into a single item (group) based on certain criteria.

2. Credential: Data assigned to an entity and used to identify that entity.
3. Designated One Person Control: Requires that a designated cardholder is present before anyone else is allowed to access a certain area.
4. Designated Two Person Control: Requires the presence of two cardholders, designated as special "Team Members", to restrict individuals from being alone in restricted or highly secure areas as well as restricting the type of personnel allowed in those areas.
5. Devices Global Hard Anti-passback: Once access has been granted via a valid badge presentation, (1) a cardholder cannot present their badge to another entry card reader within the same area without first presenting it to the area's exit card reader, and (2) any attempt to use any card reader in the same area other than exit card reader shall result in access denied and an alarm report.
6. First Card Unlock: Function where a pre-determined time zone activated unlock command is suppressed until a valid credential has been presented and granted access to the portal.
7. Global Soft Anti-passback: As defined in Devices Global Hard Anti-passback with the exception that the cardholder shall be allowed access to a new area for which he is authorized.
8. (Guard) Tour: One or more checkpoints (card readers or alarm inputs) checked during a guard's predetermined path.
9. Interlock group readers: Configuration for local, but not global, anti-passback whereby only one door may be opened at a time within the area and an alarm is generated for any denied access.
10. Pass-Through: The ability assigned to a person's credential that allows them to access a door even if in lockdown state.
11. Occupancy Limit: Restricts the number of cardholders that shall be present in an area at any given time.
12. Region: A separate instance of the distributed database.
13. Representational State Transfer (REST): A software architecture style consisting of guidelines and best practices for creating scalable web services.
14. RESTful API's (Application Programming Interfaces): Term given to Web services using the REST architecture.
15. Runaway detection: A situation when there are more than a specified number of alarms coming from a given device within a specified time interval.
16. Tailgate Control: Triggered when a person receives an access granted, an output will be fired momentarily for a single person or twice for two people, for a maximum duration of one second.
17. Timed Anti-passback: Configurable wait time between an initial badge swipe and the time at which the same badge will be accepted again at the same card reader.
18. Timezones: Time-based periods, encompassing time of day, day of the week and holidays, which are stored on the ISC and control hardware behavior, cardholder access, online mode of the readers, activation of outputs, masking of inputs, and logging events to the database.



19. Two Person Control: Restricts access to certain areas unless two (2) cardholders are present, where the second badge must be presented within a designated time interval of the first to provide access.

C. Reference Standards

1. Underwriters Laboratories
  - a. UL 294 - Standard for Access Control System Units
  - b. UL 1076 - Standard for Proprietary Burglar Alarm Units and Systems
  - c. UL 1981 - Standard for Central-Station Automation Systems
  - d. UL 1610 - Central Station Automation System Software
2. ISO/IEC 14443-3:2011 – Identification Cards
3. ADA – Americans with Disabilities Act
4. National Fire Protection Association
  - a. NFPA 70 National Electric Code
  - b. NFPA 101 – Life Safety Code
  - c. NFPA 731 - Standard for the Installation of Electronic Premises Security Systems
5. Institute of Electrical and Electronic Engineers
  - a. IEEE 802.3 Ethernet Standards
6. National Institute of Standards and Technology (NIST)
  - a. Federal Information Processing Standard Publication 140-2 – Security Requirements for Cryptographic Modules
  - b. Federal Information Processing Standard Publication 197 – Advanced Encryption Standard
  - c. Federal Information Processing Standard Publication 201 – Personal Identity Verification
  - d. SP 800-116 A Recommendation for the Use of PIV Credentials
7. Security Industry Association
  - a. Open Supervised Device Protocol (OSDP)
8. Video
  - a. ISO / IEC 10918 – JPEG
  - b. ISO / IEC 14496 –10, MPEG-4 Part 10 (ITU H.264)

D. Submittals

1. Informational Submittals
  - a. Product Data
  - b. Manufacturer product data sheets
  - c. Manufacturer product instructions, and installation and operating manuals
  - d. Shop Drawings

- 1) Complete set of proposed drawings, identifying equipment locations, types of cabling, numbers of conductors, raceway locations, and termination points of each conductor.
  - 2) Complete listing of proposed devices, indicating interconnection equipment locations and specifying terminal/connecter termination locations.
  - 3) Operational narrative of each component/system.
2. Closeout Submittals
    - a. Warranty Documentation:
      - 1) Manufacturer warranty statements for all system components and applicable equipment.
  3. Record Documentation:
  4. Maintenance Material Submissions:
    - a. Listing of spare parts required to maintain the system.
  5. Closeout Submittals
    - a. Final listing of doors, locations, and normal status in MS Excel format.
    - b. Complete set of supplier's operating instructions, installation instructions, and troubleshooting guide, to include but not be limited to instructions for:
    - c. Schematic drawings depicting type and location of interface equipment/components,
      1. number of cables and conductors, raceway locations, types of connectors, circuit requirements and type and dimensions of enclosures.

**1.04** Quality Assurance

A. Contractor qualifications:

1. Company with a minimum of 2 (two) years system design, engineering supervision, and installation experience in the access control industry.
2. Contractor must be a current, authorized reseller for the OnGuard product and manufacturer, and provide evidence thereof.

B. Manufacturer Qualifications

1. The Hardware and software manufacturer(s) shall have delivered security management products for at least 10 (ten) years, and shall have a sufficiently large and diverse installed base to ensure competence in delivering, deploying, and supporting systems of this type and scale throughout their expected service life.

**1.05** Product Delivery, Storage, and Handling

- A. Acceptance: Upon delivery to the site, Contractor shall inspect all products and materials for any damage.

**1.06** Project Conditions

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results.

**1.07** Manufacturer Capabilities

- A. Advanced Services - The Software Manufacturer shall have an in house Advanced Services group available to contract for:
  - 1. Professional engineering services to include on-site or remote advanced support, enterprise planning and advanced deployments, system design, supporting software tools, database migrations and conversions, emergency service, system assessments.
  - 2. Remote Management and Embedded Services to include project management and coordination, contract management, VAR coordination, and Manufacturer resource coordination
  - 3. Custom applications and reports.
- B. 3<sup>rd</sup> Party Product Certification Program
  - 1. The SMS Manufacturer shall have a Partner Program that allows other products to develop interfaces to the Security Platform based on a RESTful Web Services API.
    - a. Third-party integrations shall have been certified by SMS Manufacturer personnel.
    - b. Each new revision or version of the third-party system shall be subject to recertification.
  - 2. Interfaces developed shall be tested and certified by the SMS Manufacturer for each new version of product released. The Certification Program shall have integrations which include, as a minimum, Command and Control, Key Management, Fire Detection, Intrusion, Elevator and Critical Communication products, and the capability to integrate with other security and non-security products, as desired by the customer.
- C. Global Support Capability
  - 1. The SMS Manufacturer shall have dedicated global support mechanisms in place to provide local support to any installation covered by this specification, regardless of location throughout the world.
  - 2. The SMS Manufacturer shall have multiple independent Value Added Reseller (VAR) options to support customers in each market.
  - 3. The SMS Manufacturer shall have a proven and demonstrable history of deploying Enterprise-scale solutions to Global customers.

**1.08** Warranty and Support

- A. Manufacturer shall warrant that the physical media on which the Software is distributed, if applicable, is free from defects in materials and workmanship and that the Software will function in substantial accordance to the Documentation that accompanies the Software for a period of one (1) year from the date of shipment of the Software to the reseller. This limited warranty is void if failure of the Software results from accident, abuse, modification, misapplication, misuse, abnormal use or a virus.
- B. Hardware warranties shall be provided by the original manufacturer of the specific hardware device or component.
- C. Manufacturer shall offer a supplemental software support program to include software updates and upgrades.

**1.09** License

- A. The SMS shall only require a single license key to be present on the database server for the SMS to operate.
  - 1. A license key on the database server shall determine the number of client workstations that shall be able to connect to the SMS and access its functionality.
    - a. The license key shall either be a physical device or a software license key.
    - b. License keys shall not be required at the client workstations.
  - 2. The SMS shall allow the SMS user the ability to activate, return, or repair the software license key.
  - 3. The software license shall only be used on a physical computer or in a VMware virtual environment.

#### 1.10 Localization (Language)

- A. The SMS (Security Management System) shall provide language support for interface and database by default or by installation of specific localization packages. Support shall be written using Unicode format and have the capability to support both single-byte and double-byte languages, with the list of languages to available. Localized versions of documentation may be available.
  - a. Required languages: English, **<Insert additional languages required for project>**

## PART 2 PRODUCTS

### 2.01 Manufacturer

#### A. LenelS2

1. 1212 Pittsford-Victor Road, Pittsford, NY 14534-3820

Phone: +1 585 248-9720

info@lenel.com

2. Products

- a. Security Management Software: OnGuard 7.6 or later

### 2.02 General Description

- A. The Security Management System (“SMS”) shall be the key central component for managing physical security access control, **<video>**, **<alarm monitoring>** **<visitor management>** **<and selected other functions provided through third party integrations as specified herein>**.
- B. Scalability
  1. The SMS shall be capable of processing an unlimited number of credential readers, scalable from single site to multiple sites.
- C. Database
  1. The SMS shall be based upon one or more independent secure SQL database instances, one of which has been designated as the system master.
- D. The SMS shall provide a variety of integrated core functions to include:
  1. regulation of access and egress
  2. provision of identification credentials
  3. video management
  4. monitoring and managing alarms related to both access control and intrusion
  5. visitor management
- E. Integrations – The SMS shall employ a RESTful, Web Services API to enable the integration of select third party products and functions with the core functions of the SMS.
- F. User Interface
  1. The SMS shall provide access to licensed and installed applications through a common browser-based launcher application that can invoke various components and modules of the SMS from a single location, with users able to customize, rearrange, and retain configurations.
    - a. This launcher shall offer Single Sign On and enable launch of both Windows and browser clients.
- G. Communication Security

1. All communication paths within the SMS shall support encryption to provide end-end communication security.

#### H. User Login and Authentication

1. The SMS shall offer both a native capability to manage system users, as well as the option to authenticate system users through an external Active Directory, LDAP, or OpenID Connect® (OIDC) system. Solutions that do not support OpenID Connection authentication of system users shall not be acceptable. System shall also allow for denial of login after a specified number of failed retries.
  2. System shall also log the user out of any browser clients after a specified period of inactivity.
  3. Customizable login message and ability to link to external websites or documents.
- I. The SMS should provide the ability for control of expiration and complexity for the User Account Passwords internal to the system such that system could comply with existing NIST and NERC guidance.

Complexity options to include: Upper/Lower Case, Numeric, Special Characters, Minimum Length, Prohibited List, and Password history

Expiration options to include: Number of days as well as administrator enforced update of password.

#### J. Operational Efficiencies

1. The SMS shall offer a self-service portal for employees to request access and for area owners to approve, hold or deny requested access. This web portal shall also offer administrator-configurable self service functions for cardholders such as PIN change, setting up a visitor and visit record, and resending a mobile credential to their mobile device.
2. Transactions shall be reportable within the SMS.
3. The SMS shall offer an expedient means to identify access rights provided in violation of corporate policies and to automatically revoke access rights for these violations.
4. The SMS shall offer a browser-based analysis tool that collects system data for comprehensive system health monitoring and displays it on a customizable, intuitive dashboard.

### 2.03 Architecture

#### A. Open Architecture - The SMS shall support an 'open architecture' allowing for additional support of products outside of the vendor proprietary options.

1. SMS shall support hardware that is non-proprietary such that other vendors could readily offer support for these devices. Access Control Panels that are only supported by a single SMS provider shall not be acceptable.
2. SMS shall support a RESTful Web Services Application Programming Interface (API) that supports the opportunity for 3rd party integration. Access to this API should be managed through a program to ensure that certified integrations utilize this API appropriately.
3. The SMS shall, when possible, leverage open or industry standards for device and system design.

#### B. System Topology

1. The SMS shall include a central or distributed server component for managing security and any associated integrations.
  - a. The SMS server shall function as an application server for connectivity of workstation based or browser-based clients for support of configuration and management.
2. An input or output linkage feature shall allow linking of input points to output control points.
3. Tasks shall be accessible from compatible client workstations on the network utilizing any of the following:
  - a. Traditional client-server architecture, using either Windows clients or browser clients for common day-to-day tasks.
  - b. Support for federated system architecture (multi-server, multi-database) where the SMS supports the expansion of the system architecture and allows for user deployment based upon their system architectural needs
  - c. Centralized distribution (publishing) of applications using Windows Terminal Server and Citrix® on Windows, UNIX, Linux or Apple Macintosh based systems through any compatible internet browsers and/or by means of a mobile computing platform or mobile device.
4. Redundancy - The SMS shall support the following means of fault tolerance and SMS redundancy:
  - a. Hot Standby Servers - A Primary Server shall be the main server that is in use when the SMS is operating under normal conditions, and the SMS shall mirror its database information to a Backup/Secondary Server.
    - 1) Field hardware shall be configured for both the Primary Server and the Backup Server, which shall each recognize the same TCP/IP ISC address on the network.
    - 2) Upon sensing Primary Server failure, the Backup Server shall automatically initiate itself as the Primary Server and shall begin communication with the Field Hardware.
      - a) Frequency of check for Primary Server failure: 5 seconds
      - b) Resynchronization time upon Primary Service restoration: 5 minutes maximum
  - b. Cluster/Warm Standby - A Primary Server shall be the main server that is in use when the SMS is operating under normal conditions.
    - 1) Field hardware shall be configured for both the Primary Server and the Backup Server, which shall each recognize the same TCP/IP ISC address on the network.
    - 2) Upon sensing Primary Server failure, the Backup Server shall bring the necessary services online and shall begin communication with the Field hardware.
    - 3) Shared media devices, either single or dual, shall be employed to house the hard disk used by both servers.
      - a) Resynchronization time upon Primary Service restoration: 5 minutes maximum
  - c. Disk Mirroring - This configuration shall allow data to be stored on dual hard disks running simultaneously.

- d. RAID Level 10 - The SMS shall offer a Fault Tolerant Redundant Array of Independent Disks Level 10 (RAID Level 10) with a hot standby disk.
    - 1) Redundant components: disk storage, controller channels, high efficiency power supplies
  - e. Distributed Intelligence - In the event SMS communications is lost or the database server fails, Intelligent System Controllers shall provide complete control, operation and supervision of the system's monitoring and control points.
    - 1) Should the downtime exceed the capacity of the Field Hardware buffer and events are overwritten, an alarm shall appear in the Alarm Monitoring Window notifying the System Operator that events were overwritten.
- C. Inter-site Communications
- 1. The SMS shall support a distributed system (application and database) installation to support geographical or logical separation and management of installations while maintaining a centralized system for reporting.
    - a. Each distributed system shall support operation of the local clients and hardware, and provide configuration, event, and transactional events to the central system.
    - b. The SMS shall use a message architecture to transfer necessary incremental credential data from one site to another. This architecture shall provide data queuing, guaranteed delivery, and secure transmission of this data.
- D. External Interaction of Data
- 1. The SMS shall be able to connect to and interface bi-directionally with external data sources utilizing the following methods:
    - a. ASCII with support for XML formatted text exchange
    - b. Real-time exchange of data via Active Directory or LDAP
    - c. Software Application Programming Interface (API)
- E. Database - The SMS shall utilize a single supported relational database.
- 1. Acceptable databases: Microsoft SQL, Oracle
  - 2. Acceptable operating systems: Microsoft Windows Servers or Clients
  - 3. Protection of 'Data at Rest' within the database shall be provided via SQL Transparent data encryption (TDE) and shall be supported to perform real-time I/O encryption and decryption of the database and database log files.
  - 4. The SMS database server shall support an unlimited number of cardholders and visitors limited by the available memory, storage, and processing of the devices. The SMS database server shall support an unlimited number of system events and System Operator transactions in the history file limited only by available hard disk space. The SMS database server shall support an unlimited number of system events and System Operator transactions in the history file limited only by available hard disk space.



5. The SMS shall support bi-directional data interface to external databases in real-time or in a batch mode basis.
  - a. The SMS shall support a one-step download and distribution process of cardholder and security information from the external database to the SMS database and through the system to Intelligent System Controller (ISC) databases.
  - b. If a required communication path is broken, the data shall be stored in a temporary queue and shall be automatically downloaded once the communication path is restored.
- F. Security
  1. Each page in the cardholder record shall be permission protected.
  2. Each field in the database shall be permission protected.
  3. Communication throughout the SMS shall be AES encrypted, using TLS where practical.
  4. All cardholder PIN codes within the system shall be encrypted.
- G. A Network Account Management Module shall integrate SMS cardholders with external user network accounts, allowing System Administrators to perform a set of administrative tasks in Windows domains from the System Administration Module, and to create a link between physical access control and logical domains.
- H. The SMS shall allow, through standard API toolkits, System Administrators to expose specific SMS data and events that are relevant to IT information or other third-party systems or to allow, System Administrators to accept and process information exposed from the IT information or other third-party systems.

#### **2.04 Core Functionality**

- A. Access Control - access granted or denied decisions, define access levels, and set time zones and holidays. The SMS shall support features such as area control (two-man control, hard, soft, and timed anti-passback), database segmentation, and time zone or holiday overrides
  1. Configuration
    - a. Credentials
      - 1) SMS credential management functionality shall allow:
        - a) enrollment of cardholders via traditional thick client and/or by a browser-based credential application for the storage of cardholder records in the database
        - b) formatting of cardholder records
        - c) capturing of images, biometric data, and signatures
        - d) user-defined fields in the cardholder record
        - e) issuance / reissuance of traditional plastic badges and/or mobile credentials using information in the cardholder record. It shall be possible to print to a designated, configured badge printer from both browser-based and Windows clients. This mechanism shall be based on a print server architecture supported by the SMS. Solutions requiring a printer directly connected to the device on which the browser client is used shall not be acceptable.
        - f) import or export of cardholder data from internal or third-party systems

- i. data delimiter: definable
    - ii. import-export filters: selectable
  - g) assignment and modification of access rights and levels
  - h) definition of cardholder escort requirements
  - i) cardholder use limits
  - j) user definition of extended individual strike and door held open times
  - k) deactivation of credential following a period of non-use
  - l) furnishing and management of digital certificates for smart cards
  - m) searching for records and images based on any fields in the database
- 2) Field types: text, date, numeric, drop-down lists
- b. Access Levels shall consist of a combination of readers and timezones.
  - 1) Minimum number of supported access levels per controller: 32,000
  - 2) Minimum number of supported access levels per badge: 255
  - 3) Card readers shall be assignable to any or all access levels.
  - 4) Each access levels shall have the option for "First Card Unlock".
  - 5) Temporary access levels - Within the constraint of number of access levels, the SMS shall have provision for access levels with definable start and end dates.
  - 6) Precision access levels - Beyond the constraint of number of access levels, the SMS shall be able to assign access levels with unlimited card reader and timezone combinations.
  - 7) Access Groups - The SMS shall provide for access groups, assignable to an alphanumeric name, containing up to 32 access levels.
  - 8) Timezones - Pre-defined card reader settings shall have the flexibility to be overridden or modified for locking state and required authentication means.
- c. Holidays shall be assignable via an embedded calendar with an alphanumeric name and to individual timezones.
  - 1) Minimum number of holiday assignments: 255
  - 2) Number of holiday group types: 8
  - 3) Repeat frequency: annual
  - 4) Daylight Savings Time: definable for automatic time conversion
  - 5) Span: configurable for multiple days
- d. Timezones
  - 1) The SMS shall be capable of creating timezones, each with intervals assignable to any day of the week.
    - a) number of timezones: 255 minimum

- b) Intervals: 6 minimum
- 2) Timezones shall be allowed to belong to any or all access levels so that the time zone only has to be defined once.
- e. Scheduling - The SMS shall have a scheduling utility to allow System Administrators to schedule actions to occur on a one-time or a recurring basis and to maintain a log of actions executed.
- f. Field Hardware
  - 1) The SMS shall allow for a Windows-based configuration of the following types of field devices which participate in the access control function:
    - a) Intelligent System Controllers (ISC's)
    - b) Input Control Modules (ICM's)
    - c) Output Control Modules (OCM's)
    - d) Access card readers
    - e) Integrated lock-readers
  - 2) The SMS shall provide a device discovery utility to aid in configuration.
    - a) Scope: local subnet or multiple subnets
    - b) Display categories: brand, discovery service, device status, device type
    - c) Available functions: ping, reboot, default password check, version discovery, launch device web server, save credentials, update IP address

*Functions depend upon specific capabilities within a device.*
  - 3) When a field hardware device is configured, the device shall appear in a graphical system overview tree and be available in drop down lists which support operator access.
  - 4) The SMS shall have the ability for bulk add, modify, and delete privileges for ISCs and card readers to allow for the ease of addition and maintenance of themes.
  - 5) The System Administrator shall have the ability to group field devices into monitor zones.
  - 6) System status update frequency shall be configurable.
- g. Alarm Masking Groups - System Administrators shall be able to create groups of alarm inputs that enable them to mask or unmask multiple Input Control Module inputs and card reader inputs simultaneously.
  - 1) Alarm Masking Groups shall be able to be masked or modified as a group or as individual points.
  - 2) Alarm masking shall support two-man control.
  - 3) Number of Alarm Masking Groups: maximum 64 per ISC
  - 4) Alarm inputs: maximum 128 per Alarm Masking Group

- h. Event Linkage - The SMS shall support a global linkage feature whereby any input or output or event shall be linked to any other input or output or event., with the following additional characteristics:
    - 1) support global I/O function lists, consisting of sequences of up to six actions
    - 2) association with panel areas
  - i. Graphical Maps - The SMS shall support graphical maps that display device or group status, function lists and video cameras dynamically in real-time, and support the following:
    - 1) configuration to appear on command or when specified alarms are acknowledged
    - 2) graphical map creation software that allows the import of map backgrounds from supported file formats  
*Please refer to attachment for a list of supported file formats.*
    - 3) associate various maps with each area to provide for the creation of a map hierarchy
    - 4) user-defined text and icons
    - 5) configuration of map icon shape and color to represent the state of the associated device
2. Badging - SMS badging functionality shall allow for the creation of different badge types based on a database field, the linking of that field to a badge type to automate the process of credential production, and the use of security colors, chromakey, and ghosting, to allow quick identification of personnel access authority.
- a. The SMS shall have the ability to create and maintain badge designs, with tools and support for image import and export, ghosting, signature capture, bar code, and smart card chips.
    - 1) Image formats: all standard industry image formats
    - 2) Support image processing and effects with a pre-defined effects gallery.
    - 3) A badge layout and creation module shall support custom badge designs by the User.
  - b. Additional badging related functionality shall include the following:
    - 1) assignment of access levels and access groups, including bulk assignment, modification or deletion of access levels
    - 2) custom badge layout
    - 3) mobile and remote badging
    - 4) printing: print limits, batch printing
    - 5) magnetic stripe encoding using any of three tracks
    - 6) support for all industry standard bar code formats
  - c. Credential images shall be digitized using industry standard JPEG image compression and printed using a high quality and direct card printing process.

- d. The System Operator shall have the following functions available when enrolling cardholders: choose a badge type, select access levels, enter personal identification numbers (PIN), and/or any other user-defined fields.
  - e. A badge form shall keep a complete history of every badge that was assigned to the cardholder's record to include cardholder badge ID, issue code, badge type, badge status, activation and deactivation dates and times, PIN numbers, embossed numbers, and anti-passback information.
3. Ingress and Egress
- a. Individual Use
    - 1) Access Cards
      - a) Card types supported:
        - i. Proximity - 30 mil thickness, ISO compliant
        - ii. smart cards - contact and contactless
          - Schlage MiFare - 1 kB (8 kb) and 4 kB (32 kb)
          - Schlage MiFare DESfire EV1 and EV2
      - b) Data formats supported:
        - i. Magnetic stripe - with card number, facility code, and issue code combinations up to nine-digit card number and two-digit issue code
        - ii. Wiegand - all industry standard variations
        - iii. Supported mobile credentials:
          - Allegion
      - c) The SMS shall support desktop smart encoding and inline smart encoding for relevant affected reader technologies.
      - d) The SMS shall support a card reader cipher mode, emulating the presentation of a card credential by manually entering their badge ID.
      - e) The SMS shall support a configurable denied access attempts counter for each card reader.
      - f) Extended Held-Open Time - Authorized cardholders shall have the ability on demand to extend the time for which a door is held open after access is granted for up to 30 minutes.
      - g) An alarm shall be generated upon an attempt to use any badge that is not marked active in the SMS.
    - 2) Biometrics shall provide multi-factor (or alternate) identification through the measurement and comparison of human characteristics including fingerprints, hand geometry, iris imaging, and facial features. The SMS shall have the capability to verify the identity of enrolled individuals using products from approved manufacturer partners.

- a) Capture of biometric data (template) shall be accomplished via the biometric device or associated reader.
- b) Cardholder biometric data (template) storage means: smart card; in access controller; in the biometric partner database.
- 3) Request to Exit (REX) - The SMS shall be able to provide an event when a REX is initiated.
- 4) The SMS provides the ability to alert the System Operator when a cardholder does not present their credential at a required location in a designated period of time.
- 5) Pre-Alarm - The SMS shall support a card reader pre-alarm feature which sounds a tone prior to a door held open alarm for a configurable period.
  - a) The SMS shall allow operator response instructions to be specified for each type of alarm and delivered via text and/or audio.
- b. Area Control - The SMS shall implement area control implementing functionality affecting more than one person, and have the following elements:
  - 1) Global and Local Hard Anti-passback
  - 2) Global and local Soft Anti-passback
  - 3) Timed Anti-passback
  - 4) Two Person Control
  - 5) Designated One Person Control
  - 6) Designated Two Person Control
  - 7) Tailgate Control
  - 8) Occupancy Limit
  - 9) Interlock group readers
- c. Mustering - The SMS shall provide a mustering function to automatic register cardholders that are on site during an incident.
  - 1) Muster Mode shall mean that an incident has occurred and an evacuation is required of one or more a Hazardous Locations.
    - a) Triggers
      - i. automatic: occurrence of a designated hardware event
      - ii. manual: by System Operator
    - b) Reset: manual by System Operator or Automatic based on Global I/O
  - 2) Hazardous Location (s) shall be defined using entry and exit readers associated with the location.
    - a) One or more safe locations shall be designated for each a Hazardous Location.
    - b) Entry and exit card readers shall be provisioned at each portal with the requirement that a badge always be used to enter or exit Hazardous and Safe Locations.

- 3) Muster Alarm and Reporting
  - a) When a Hazardous Location is in Muster Mode, all associated Alarm Monitoring Workstations shall be notified with a breakthrough notification and Muster Reporting shall be active.
  - b) Live Muster Report
    - i. display the last location of each cardholder based on card swipe.
    - ii. activation:
      - immediately upon entering into Muster Mode
      - after a specified time period from Muster Mode activation
      - after the number of personnel in the Hazardous Location reaches a given count.
    - iii. configurable for automatic refresh time and automatic end
  - c) Muster Status Reporting: individual cardholders in Hazardous Location
  - d) Live Hazardous Location and Safe Location Reports: cardholder listing and record selection
  - e) Operator Display
    - i. Hazardous Locations and Safe Locations shall be placed on graphical maps' System Hardware Status Tree as Area Icons with associated head counts.
4. Guard Tour
  - a. A tour shall consist of a series of checkpoints that shall include card readers and/or alarm inputs.
  - b. Each tour shall be assigned to one or more alarm monitoring Workstations indicating from where automatic tours are to be launched.
  - c. Tour checkpoints shall be assigned minimum and maximum times within which to be reached.
  - d. The SMS shall handle both scheduled and random tours.
    - 1) Scheduled tours shall have an Alarm Monitoring Window pre-departure notification.
  - e. Tours will have the option of being linked to live video.
  - f. Guard tours shall capable of being monitored through a tracking window including tour details and status.
  - g. The SMS shall support aggregation of tours into tour groups.
5. Elevator Destination Dispatch
  - a. SMS shall support network/data level integration to elevator destination dispatch systems
  - b. Access control information shall be shared with the elevator destination dispatch system as needed to facilitate the access control decision

6. Direct Wired Elevator Control - The SMS shall provide elevator control using standard access control field hardware that will permit the restriction of cardholder access to certain floors while also allowing general access to other floors, with the following additional functions:
  - a. Allow, at the elevator, the use of any card reader and card reader modes used on any other card reader in the SMS
  - b. Track which floor was selected by an individual cardholder for auditing and reporting purposes
  - c. Provide an option where the floors of a building are able to be configured into logically divided sections (floor groups) to prevent passenger requests between designated sections.
7. Field Devices
  - a. Interface
    - 1) The SMS shall be equipped with the access control field hardware required to receive alarms and administer access granted or denied decisions.
    - 2) The SMS shall be capable of interfacing with the following **<categories of>** field devices:

Devices without Lenel Part Numbers

- a) Intelligent System Controllers (ISC)
- b) Intelligent Single Door Controller (ISDC)
- c) Intelligent Dual Reader Controller (IDRC)
- d) Advanced Dual Reader Controller (ADRC)
- e) Input Control Module (ICM)
- f) Output Control Module (OCM)
- g) Single Reader Interface Module (SRI)
- h) Dual Reader Interface Module (DRI)
- i) Reader Interface Module (RIM)
- j) Access Control Network Door Controllers or Network Controller/Readers
- k) Power over Ethernet Plus (PoE+) Enabled Dual Door Interface
- l) Wireless Gateway Interface
- m) Network Adapters
- n) Communication Star Multiplexer
- o) RS-485 Interface Module
- p) Network ready power supplies and enclosures
- q) Dual Reader Interface (DRI)
- r) Intelligent and combination locks

Devices with Lenel Part Numbers



- s) Intelligent System Controllers (ISC)
    - i. LNL-X3300
  - t) Intelligent Single Door Controller (ISDC)
    - i. LNL-X2210
  - u) Intelligent Dual Reader Controller (IDRC)
    - i. LNL-X2220
  - v) Advanced Dual Reader Controller(ADRC)
    - i. LNL-X4420
  - w) Input Control Module (ICM)
    - i. LNL-1100-S3
  - x) Output Control Module (OCM)
    - i. LNL-1200-S3
  - y) Single Reader Interface Module (SRI)
    - i. LNL-1300-S3
  - z) Dual Reader Interface Module (DRI)
    - i. LNL-1320-S3
  - aa) Power over Ethernet Plus (PoE+) Enabled Dual Door Interface
    - i. LNL-1324e
  - bb) Wireless Gateway Interface
    - i. PIM400-1501-KIT
  - cc) Communication Star Multiplexer
    - i. LNL-8000
  - dd) Network ready power supplies and enclosures
  - ee) Intelligent and combination locks
- 3) Migration boards - *Consult with your LenelS2 Representative for information about available migration options.*
  - 4) The SMS must be able to retrieve device serial numbers from field hardware, excluding card readers, biometric readers, and keypads.
- b. Data download
    - 1) The SMS shall provide for the downloading of data to the ISCs. Downloads shall load SMS information (timezones, access levels, alarm configurations, etc.) into the ISC's first, followed by cardholder information and card reader configurations.
    - 2) Information on cardholder status, badge status, timezones or access levels shall download in real time as they are added, modified, or deleted from the SMS.

- c. Permission control - The SMS shall allow System Administrators to set permission control for individual devices within a monitoring zone for command override.
- d. Device grouping - The SMS shall support device grouping for uniform command and control of groups of devices within the system.
- e. Card readers
  - 1) Options to include:
    - a) User commands
    - b) Door strike, REX and DPS functionality
    - c) Duress actions
    - d) Alarm masking
    - e) Logging requirements
    - f) Selection as "In" or "Out" reader
    - g) Use limits
  - 2) The SMS shall provide connectivity to, proximity/mobile ready, Smart Card and smart card/mobile ready readers which provide continuous supervision and monitoring of reader processor and wiring integrity by means of a non-proprietary communications protocol standard.
  - 3) The SMS shall support encrypted reader to panel communications using the SIA OSDP Secure Channel protocol.
    - a) OSDP File Transfer capabilities shall be supported
    - b) Flexible support for OSDP manufacturer specific commands shall be provided. It shall be possible to send commands based on a schedule or manually.
- f. Input Control Modules (ICM's) options to include:
  - 1) Alarm masking
  - 2) Local linkage of inputs and outputs
  - 3) Output activation rules
  - 4) Input configuration for Guard Tour
  - 5) Entry (latched, not latched) and Exit delay modes
- g. Intelligent System Controller (ISC) capabilities shall include:
  - 1) Administrator functions to group, add, modify or delete ISC's in the system
  - 2) Ability to update firmware or replace hardware while maintaining complete hardware and data configuration settings
  - 3) A distributed intelligence redundancy mode, whereby the ISC, configured with a UPS battery to maintain the unit for 24 hours, participates with other ISC's to provide complete control, operation and supervision of the system's monitoring and control points in the event of SMS server failure.
    - a) cardholder capacity:                      configurable up to 1,000,000

- b) event capacity: configurable up to 50,000
  - h. A system Operator shall have the option to manually control the output points or input points connected to the SMS.
  - i. The SMS shall support a real-time graphical system status tree or list window that graphically depicts configured field hardware devices.
8. Distributed Access Level Management
- a. The SMS shall provide a browser-based interface for the assignment of access rights to individuals or groups of cardholders, using a simple user-interface paradigm suitable to general employee use, and not requiring specialized training on the SMS
  - b. The SMS administrator shall have the ability to designate for which areas a manager has assignment rights. These rights shall then be reflected in the browser interface accessible by the area manager, such that only areas for which they have authority are available for assignment.
  - c. The browser-based tool for access rights assignment by area managers shall have the ability to search for cardholders and to view cardholder details, constrained by the permissions of the manager
- B. Alarm Monitoring - The SMS will provide the ability to monitor system and device Alarms/Events, Field Hardware Command and Control and Status Monitoring and system support functions, for the use of the operators of the system.
- 1. The SMS shall provide monitoring options thru workstations installed or browser-based clients.
  - 2. An Alarm Monitoring window shall provide System Operators information about the time, location, and priority of an alarm and provide the ability to sort pending and new alarms based on event detail.
    - a. Detail shall include at a minimum: Date/Time, Description, Priority, Controller, Device, and person.
  - 3. Alternate alarm view windows shall be available to support: Alarm or Badge Activity Monitoring, Event Tracing (Live/Historical), and Alarms Pending Response
    - a. Operators shall be able to acknowledge alarms from any alarm view window.
  - 4. Monitor support shall include the ability to view live and recorded surveillance video and link video to alarm events.
  - 5. Monitor support shall include options for comparison of the in-person cardholder to their stored image either in person or via live video. Cardholder Verification and Video Verification.
  - 6. The SMS shall allow a System Operator to:
    - a. monitor alarms in their assigned monitor zone and to perform field device control actions on specified devices in that zone from either thick client, web client or mobile client platform
    - b. delete the alarm from the alarm monitoring window without acknowledging the alarm
    - c. enter and edit an Acknowledgement note detailing the cause of specified alarms and the actions taken

- d. activate, deactivate, or pulse outputs configured and associated with a card reader
  - e. mask or unmask each individual card reader door forced open alarms, door held open alarms, and associated auxiliary alarm inputs
  - f. display a cardholder record with the stored cardholder's image
  - g. verify that a person using a credential matches their stored photo
  - h. open multiple cardholder verification windows to cover multiple readers at the same time
  - i. initiate several traces of cardholders, assets, and/or field hardware devices while monitoring alarms
  - j. initiate an historical trace for a device, specifying a date and time range
  - k. filter alarms from the trace window to include access granted, access denied, system, duress, and area control alarms and by alarm source
  - l. perform a trace on any ISC, ICM, Alarm Input, Credential, Intrusion Detection Device, Monitor Zone, or card reader
  - m. manually override card readers, alarm points, and relay outputs
  - n. combine, enable, or disable alarms for aggregation
  - o. acknowledge or delete a group of aggregated alarms
  - p. view runaway devices
7. System Administrators capabilities shall include:
- a. set permission control for individual devices within a monitoring zone for command override
  - b. assign default monitor zones to monitoring workstations
  - c. option to define monitor zones to include sub devices of an ISC
  - d. configure how the SMS handles the annunciation of alarms on an individual alarm or event basis
  - e. set display parameters for unacknowledged alarms
8. Notifications - Upon alarm, the SMS shall allow for:
- a. automated sending of texts or e-mail messages
  - b. forwarding alarms to another location
9. Annunciation - The System Administrator shall have the ability to configure how the SMS handles the annunciation of alarms on an individual basis.
- a. These attributes and actions shall be assignable on a 'global' basis to all devices that share an alarm description.
10. System Administrators shall be able to route and re-route device alarms and events to defined monitoring client workstations on the network, regardless of where the alarm is generated in the field.

11. A real-time graphical system status tree on the screen shall indicate the status of devices to reflect secured, unsecured, in alarm, or offline and provide command and control functions for authorized users.
12. Output control operations shall be available to lock, unlock or pulse control points.
13. An automatic cardholder call-up feature shall allow the quick search and display of images in the database.
14. Logging
  - a. All alarms and events in the SMS shall, by default, always be recorded in the database.
    - 1) System Administrators shall have the ability to select on a time zone basis, the times required for the SMS to log specific events to the database.
    - 2) System Administrators shall have the option for Alarm or Events to be set to log or not to log particular alarms or events by individual reader or input.
  - b. A System Operator journal shall be available to log important daily events.
15. A trace function shall be available for System Operators to locate and track activity on specific cardholders, assets, video cameras, or card readers. An image comparison feature must be provided for use in conjunction with a CCTV interface.
16. The SMS shall support a Test Mode for Alarm Inputs, Door Forced Open, and Access Grants to verify that all inputs within the group are operational.

C. Intrusion Detection

1. The intrusion detection function shall employ keypad used in conjunction with a card reader, both supplied from the Manufacturer.

*The Lenel LNL-CK keypad with LCD display is required.*
2. The Alarm Monitoring interface shall be able to control the intrusion detection function.
3. Intrusion zone point types:
  - a. 24-hour point
  - b. Interior point
  - c. Perimeter point
4. Arming options:
  - a. Exit delay
  - b. Entry delay
  - c. Forced
5. Actions under User command:
  - a. Disarmed
  - b. Disarmed Fault
  - c. Armed Away
  - d. Armed Stay

- e. Armed Instant
  - f. Forced Armed Away
  - g. Force Armed Stay
  - h. Force Armed Instant
  - i. Entry Delay
  - j. Exit Delay
  - k. Alarm
  - l. After Alarm
  - m. Chime
  - n. Silence
6. System Administrators shall have the ability to define Alarm Mask Groups for sets of points to be treated as an intrusion area.
- a. Indication of events from these points shall be masked (disarmed) or unmasked (armed).
7. The SMS shall support Intrusion Mask Groups to contain individually configured intrusion points and to have the capability reporting of arming mode and state for the group.
8. Alarms shall be reported for the intrusion mask group by the SMS based on the current arming mode and state of the intrusion mask group.

D. Visitor Management System

1. The SMS shall have an integral Visitor Management traditional client or browser-based client to provide the following functionality:
- a. Allow an operator to enroll, schedule, assign to an employee, capture photos, capture signature, assign access levels, sign in or out, and track visitors as they move throughout the facilities
  - b. Support for enrollment at a desktop computer, portable computer, or mobile device
  - c. An invitation email shall be automatically transmitted to the visitor without additional operator intervention. Invitation shall include:
    - 1) Visit details including date, time, host and location
    - 2) PDF417 barcode instantly readable by the visitor check-in system
    - 3) Ability to include invitation in Apple Wallet
      - a) A wallet card for the invitation
      - b) Date, time and location information shall be provided to allow for user notification
  - d. Provide visitor data and image capture / import capability as well as image edits using pre-defined effects, Chroma key (background transparency) and aspect ratio settings
  - e. Allow for re-assignable badges and sticker badges
  - f. Provision visitor credentials and maintain visitor data, including credentials and visit history, in the SMS database to minimize re-entry of data.

- g. Search for visitor records and images using any fields in the database relevant to them.
    - h. Assign visitors to existing valid cardholders with email notification
    - i. Pre-schedule visits/events
    - j. Visitor sign-in and sign-out at a desktop computer, portable computer, or a tablet
2. The system shall support the use of a browser-based self-service portal to create a Visit Event that will include the visitor(s) record creation or modification.
  - a. Any cardholder with permissions shall be able to create a visit using a self-service portal to self-enroll visitors and create/manage events.
  - b. The Host application shall allow any Cardholder with appropriate permissions to use their Directory Account to log in and create the Event/Visit record to include:
    - 1) Visitor Name, email, phone and other personal information
    - 2) Purpose
    - 3) Sign-in location
3. The Visitor Management System shall provide a visit status user interface to include:
  - a. in-progress visits, including overstayed visits
  - b. pending visits, including late visitors
  - c. completed visits
4. Self-Service app
  - a. The Visitor Management System shall have a self-service iPad-based visitor app which allows visitors to:
    - 1) sign themselves into or out of events without assistance from a front desk attendant
    - 2) sign in/sign out a pre-registered visit or a "walk-up" visit
    - 3) update personal information (including photo capture)
    - 4) view and complete pre-recorded video content during the sign-in process (example: safety or security procedures or guidelines)
    - 5) sign or accept up to seven documents (example: non-disclosure agreements)
    - 6) print an adhesive-backed paper badge with latest photo and other pertinent information via supported printer devices
  - b. Allow for customizations related to end-user branding (logos or colors) to facilitate inclusion in the environment
  - c. Upon Sign In and Sign Out, an email, which can include a captured image of the visitor, shall be sent to notify host and security personnel of a signed in or signed out visitor.
  - d. Administration of the self-service app shall allow for custom configurations of:
    - 1) App Theme Color, Logos, and custom messages to be defined by customer
    - 2) Required documents (up to 5) such as a Non-Disclosure Agreement (NDA) or Privacy Agreement and associated acceptance and signature requirements.

- a) Such documents shall be available records stored in the database.
  - b) An Administrator shall set the renewal period for updating a photo, required signed or completed documentation based on Visit Type
  - 3) The administrator may also save a VSS image or “Pre-Set” of a configured VSS iPad and store it into the SMS database.
    - a) When new Check-In locations are created, the user may download the image or Preset that is stored in the SMS database
  - e. Visitor self-service application must be a native iOS application that automatically launches on iPad startup, and cannot be terminated or exited by the visitor.
- E. Third Party Application Programming Interface (API)
- 1. Software Integrations
    - a. Software integrations shall be based upon a RESTful Web Services API.
    - b. Access control integrations shall provide for the following functionality:
      - 1) Full Alarm Management - Send and Receive and Acknowledge alarms
      - 2) Full identity/card management (add/modify/delete) identities, cards, visitors, access permissions, etc.
      - 3) Main command and control operations including - Set Reader modes
      - 4) Add/modify/delete of operator/user permissions of the system
      - 5) Access to device and other security system configuration (e.g. panels, readers, segments, badge types, etc.)
      - 6) API support for the same functions as used by manufacturer’s browser clients, such that it is possible to implement the same features and functions as the manufacturer, but in custom applications or integrations.
  - 2. Hardware Integrations
    - a. Hardware integration shall be based upon native API plug-ins that allow for 3<sup>rd</sup> parties to map their hardware into the access system to extend the supported device set including but not limited to, Fire, Intrusion, Intercom, Video, Cameras, Readers, etc.
    - b. Integration shall provide full support for alarms, hardware status, and command and control for integrating third-party devices into the alarm monitoring software
    - c. Video integration shall allow for both third-party video to be integrated into the SMS as well as SMS video to be accessed by a third-party
- F. Video
- 1. Integrated Video Management System (VMS)
    - a. An integral VMS shall provide video response options upon alarm events to include:
      - 1) auto-launch
      - 2) change camera resolution and/or frame rate
      - 3) activation and positioning of PTZ camera



- 4) event monitoring
  - 5) display of alarm location on multimedia graphical maps
  - 6) event investigation
  - 7) automatic archive of event video for selected alarm types
  - 8) instant replay of up to 5 (five) minutes of video must be provided
  - 9) to protect privacy, role-based restrictions shall be provided on the ability of an operator to search recorded video beyond a specified age
- b. Windows Client capabilities:
- 1) export of security evidence clips in industry standard formats
  - 2) switching between live and recorded video
  - 3) 2-way audio support
  - 4) search recorded video by specific badge or alarm point
  - 5) operation using same user SMS authenticated credentials
  - 6) shall provide instant rewind capability
- c. Browser Video Viewing Client capabilities:
- 1) browser client shall not require additional software or plug-in installation
  - 2) view live and recorded video
  - 3) calendar-based recorded video search
  - 4) operation using same user SMS authenticated credentials
  - 5) ability to organize multiple camera tiles into multiple layouts for convenient monitoring, such as 2 x 2, 3 x 3, 1 + 5, 1 + 8
  - 6) control for PTZ cameras and client presets
  - 7) step-through recorded video in forward or reverse
  - 8) display interactive hardware tree with device status
  - 9) support for monitor zones and user permissions
2. Integrated Network Video Recorder
- a. Supported resolutions: QVGA (320 x 240) to 20 Megapixel (5472x3648)
  - b. Recording modes: continuous, time-lapse, event-driven, synchronized audio and video
  - c. Storage options: Direct Attached Storage (DAS), Network Attached Storage (NAS), and Storage Area Networks (SAN).

**2.05** Optional Capabilities - The SMS shall allow for the inclusion of additional capabilities.

- A. Conversions and Migrations - Manufacturer shall offer the capability to migrate systems from the following manufacturers (equipment)
  - 1. Mercury
  - 2. Honeywell
  - 3. GE Security / Infographics ACU
  - 4. GE Security / CASI - M Series
  - 5. Johnson Controls - Tyco (Software House®)

*Consult LenelS2 for approved list of migration equipment.*
- B. U.S. Federal Government
  - 1. The SMS shall be compliant with US Federal Government Personal Identity Verification Authentication Standards for readers and credentials as defined in FIPS 201-2 to include the following criteria:
    - a. The solution proposed must be listed on the FICAM (Federal Identity, Credential, Access Management) Approved Products List.
    - b. The solution proposed must support certificate authentication of the FIPS-201 credentials at each entry, through a connection from the SMS components to the Federal Bridge. Systems that rely on an additional hardware component whose primary function is solely the validation of credentials shall not be acceptable.
    - c. Cryptographic portion of the SMS approved through the NIST FIPS 140-2 cryptographic validation program.
- C. Policy Compliance and Enforcement tool
  - 1. The SMS shall have a browser-based analysis tool to ensure that the SMS is correctly configured to enforce corporate security policies.
  - 2. A SMS policy manager shall be an application with the following capabilities:
    - a. Incorporates a flexible policy editor that allows the administrator to define complex security policies without having experience programming the SMS.
    - b. Allows or disallows exemptions on a per-policy basis.
    - c. Facilitates automatic or manual correction of policy violations.
    - d. Incorporates auditing and reporting capabilities to meet compliance in regulated industries.
    - e. Processes multiple violations simultaneously with bulk operations.
- D. Web Access and Trending for Comprehensive Health Monitoring
  - 1. The SMS shall provide a self-monitoring tool for SMS system application, database, and communications servers.
    - a. The monitoring tool shall constantly measure key performance indicators (KPI's) of the system servers, and provide a browser-based portal for viewing, analyzing, and understanding system operations.
      - 1) An overview screen of SMS server operation shall be available, as shall individual screens for each server.

- b. Monitoring shall default to a current-time view, with an option to specify a time window to understand system performance and metrics during the specified time window.
  - c. The SMS shall allow thresholds to be set for key performance indicators and for other system measurements and monitors, and for email notifications to be automatically generated when thresholds exceed or fall below configurable limits.
- E. Cardholder Self Service browser-based portal
- 1. The SMS shall allow cardholders to log into a browser-based interface to self-execute common tasks, including:
    - a. Enrolling visitors and scheduling visits in the SMS visitor management system
    - b. Requesting access either from a list of allowed access levels and readers, or from a log of doors where access was attempted but denied.
    - c. Changing their cardholder PIN number for the SMS
    - d. Requesting a re-send of the cardholder's mobile credential  
*Only supported for LenelS2 BlueDiamond™ mobile credentials*
  - 2. The Cardholder Self-Service tool shall generate email to notify approvers when access has been requested, and cardholders shall be notified automatically of the disposition of an access request.
  - 3. It shall be possible for the system administrator to enable or disable each of the self service capabilities listed above.
- F. Console for Launching Common Functions
- 1. The SMS shall include a launcher application that can be used from a web browser and launch various components and modules of the SMS from a common location.
    - a. The launcher application shall operate on a variety of platforms, including but not limited to Windows, Mac, and IOS, and shall feature a responsive user interface that adapts to the resolution, screen size, and aspect ratio of the device from which it is launched.
    - b. When invoked from a Windows-based computer, the launcher application shall support both Windows applications and browser-based applications.
    - c. Common applications shall be prepopulated in the launcher, but it shall be possible to integrate other browser-based applications by URL, to allow additional security application to be easily accessed by the operator.
    - d. It shall be possible to rearrange the applications in the launcher on a particular device, and have that arrangement remembered automatically for future sessions.
    - e. The launcher shall manage the login of system users, such that logging in to the launcher authenticates the logged in user for other system functions during that session.
- G. Third Party Integrations
- 1. The SMS shall support multiple certified integrated third-party interfaces with hardware and software vendors to include the following functional areas:
    - a. command and control
    - b. communications
    - c. elevator

- d. fire alarm
  - e. identity and access management
  - f. intercom
  - g. intrusion detection and alarm
  - h. IP video cameras
  - i. key management
  - j. license plate recognition
  - k. monitoring and dispatching
  - l. RFID
  - m. readers
  - n. recording appliances
  - o. sensor inputs
  - p. time and attendance
  - q. video analytics
  - r. video management systems
2. The SMS shall provide a set of standard RESTful Web Services Application Programming Interfaces (API's) and supporting documentation that allows hardware manufacturers and software application developers to interface their products into the SMS.
  3. Third party interfaces shall be integrated to provide a single graphical user interface, single source code base, and a single database for configuration, alarm, and event storage.
    - a. The SMS shall allow alarms and events from the third-party systems to report into the same main Alarm Monitoring window as access control alarms.
    - b. Third-party hardware alarms and events shall be stored in the SMS database for audit trail and reporting purposes.
  4. Data available through these interfaces shall be organized for optimum performance with one application accessing a single bank of data.
  5. Any changes to system hardware shall be instantly available across the entire SMS.
- H. The SMS shall support OPC, BACnet and SNMP protocols.
1. An industry standard OPC Server utility shall allow the export of SMS alarms and events to industry standard OPC Clients.

## **2.06** Communications

- A. The SMS shall communicate with the ISCs via TCP/IP through IPv4 or IPv6 protocols.
- B. Download communication between the SMS and the ISC shall be fully multi-tasking and shall not interfere with operational functions.
- C. Upon loss of communications between the SMS Server and an ISC, an alarm shall be created with a time stamp.
  1. Upon re-established communication, the SMS and the ISC shall automatically re-synchronize from the point of communication loss without operator intervention.
  2. The SMS shall support Dual Path communications between the SMS Server and the ISC's to allow for a fully functional redundant communication path.

- a. During a fail over period, the ISC shall periodically check to see if the primary path has been re-established and will automatically switch back upon a successful connection.
  - b. Alarms shall be generated upon loss or restoration of communications.
- D. Encryption - The SMS shall provide encrypted communication capabilities as follows:
- 1. Credentials to Reader: DESFire EV1 or EV2,
  - 2. Reader to Downstream Panels: OSDP Secure Channel Encryption
  - 3. Downstream Panels to ISC: AES-128 bit or AES-256 bit
  - 4. Data on ISC AES-256 bit Encryption of Data at Rest
  - 5. ISC to SMS Server: AES-128 bit or TLS1.2 with AES-256 bit
  - 6. SMS Server to Client: HTTPS
  - 7. Client to Printers and Badge Encoders: Encrypted encoder communications

## 2.07 System Management

- A. System Configuration - The SMS shall provide system icons and/or menu selections for each function requiring configuration of SMS options or peripherals including client workstations, field hardware, network functions, communications, and reports.
- 1. A set-up assistant utility shall be available for the initial system configuration prior to first log in.
  - 2. The SMS shall support configuration setup wizards to guide System Administrators through the configuration of the access control module of the system.
- B. In addition to capabilities previously mentioned herein, System Administration capability shall include the following:
- 1. Customize cardholder, asset, and visitor forms.
  - 2. Import customized map backgrounds and custom icons.
  - 3. Bulk delete cardholder records.
  - 4. Limit System Operator functions and actions, including searching the database.
  - 5. Configure client workstation applications and settings.
  - 6. Assign System Operator passwords, log on credentials and permissions and provide operator history.
- C. The SMS shall provide support for single sign-on capability, whereby System Administrators or System Operators may authenticate into SMS applications using their Windows domain account.
- D. System Administrative tasks including defining client workstation and Operator permissions, access groups, time zones, reports, and maps shall be available from any client workstation on the network.
- E. Graphical Features
- 1. The SMS shall display a graphical representation of configured field hardware (including ISCs, fire panels, intrusion detection devices, personal safety devices, intercom systems, and Central Station alarm receivers), digital video hardware, access levels, time zones, access groups, holidays, and card formats.

2. System Administrators shall be able to modify a device that is depicted on the graphical system overview tree or see its properties by double-clicking on the related icon, causing the SMS to bring them to the appropriate form.
- F. The SMS shall provide context-sensitive help files to guide System Administrators and System Operators in configuration and operation.
- G. Logging - The SMS shall provide full System Operator activity tracking/logging of critical keyboard functions to include date/time, Operator, activity program, function, and database changes.
1. System Operator functions to log shall include System Operator login and System Operator logout; Additions, Changes, and Deletions to Cardholder Management; New Badge, Print Badge, and Update Badge.
  2. Configuration changes to log shall include all functional modules within the SMS.
  3. The SMS shall log activity of System Operators performing SMS alarm monitoring including alarms acknowledged, alarms cleared, output control activity, trace, and other functions.
- H. Reporting - The SMS shall have a rich reporting function, storing its reports in the database and viewable from any client workstation with permissions.
1. The SMS shall provide an ad hoc customized report generator, allowing the creation of reports using the relational database structure.
  2. The SMS shall support an industry standard, off the shelf, custom report writer.
- I. Archiving - The SMS shall allow System Administrators to archive offline history files. Offline files shall include access events and System Operator transactions that have been purged from the reportable database.

## 2.08 Hardware Requirements

- A. The Manufacturer shall publish a summary of recommended server hardware to accommodate the performance requirements of the SMS server software.
- B. The SMS server software shall be capable of running in a virtual or cloud environment.

## 2.09 ELECTRONIC ACCESS CONTROL LOCKSETS AND EXIT DEVICE TRIM

- A. Manufacturers:
1. Scheduled Manufacturer and Product: Schlage AD Series.
- B. Product: Schlage AD-300 adaptable bored-type electronic lockset.
1. Provide bored cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, non-handed, field-reversible.
  2. Backset: **2-3/4-inch (70 mm)**
  3. Latchbolt Throw: 1/2-inch (13 mm) unless noted otherwise. Provide 3/4-inch (19 mm) throw for UL listing at pairs.
  4. Chassis: Standard 161 cylindrical lock prep for 1-3/4-inch (44 mm) doors
- C. Product: Schlage AD-300- MS/MD adaptable mortise-type electronic locksets.

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1 Operational, Grade 1 Security at locks with non-interchangeable cores, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Provide lock case that is field reversible for handing without opening case.
  2. Backset: 2-3/4-inch (70 mm), nominal.
  3. Latchbolt: 3-piece, beveled, stainless steel with 3/4-inch (19 mm) throw and anti-friction latch.
  4. Deadbolt: Where deadbolt function is scheduled, provide stainless steel deadbolt interconnected with latch 1-5/8-inch (41 mm) high and 5/8-inch (16 mm) thick with 1-inch throw.
  5. Chassis: ANSI/BHMA standard mortise lock prep for 1-3/4-inch (44 mm) doors
- D. Product: Schlage AD-300-993 adaptable electronic exit device trim.
1. Provide exit device trim conforming to ANSI/BHMA A156.25, non-handed, field-reversible.
  2. Exit Device Configurations: Exit device lever trim to retract latchbolt for following exit device applications:
    - a. Rim
    - b. Surface vertical rod
    - c. Mortise
    - d. Concealed vertical rod
    - e. Concealed vertical cables
  3. Exit Device Compatibility: Provide exit device trim with universal mounting plate enabling operation as required.
- E. Requirements:
1. Provide adaptable electronic access control products that comply with the following requirements:
    - a. Listed, UL 294 - The Standard of Safety for Access Control System Units.
    - b. Compliant with ANSI/BHMA A156.25 Grade 1 Operation and Security.
    - c. Certified to UL10C, FCC Part15, Florida Building Code Standards TAS 201 large missile impact, TAS 202 and TAS 203.
    - d. Compliant with ASTM E330 for door assemblies.
    - e. Compliant with ICC / ANSI A117.1, NFPA 101, NFPA 80, and Industry Canada IC.
  2. Functions: Provide functions as scheduled that are field configurable without taking the adaptable electronic product off the door.
  3. Emergency Override: Provide mechanical key override; cylinders: Refer to "KEYING" article, herein.
  4. Levers:
    - a. Vandal Resistance: Exterior (secure side) lever rotates freely while door remains locked, preventing damage to internal lock components from vandalism by excessive force.
    - b. Provide non-handed lever trim that operates independently of non-locking levers.
    - c. Style: Rhodes
  5. Power Supply:
    - a. Networked – hardwired
      - 1) Adaptable electronic access control products powered by 12VDC or 24VDC power supply with max current draw not to exceed 250mA.
  6. Features:

- a. Audible feedback that can be enabled or disabled.
  - b. Tamper-Resistant Screws: Tamper torx screws on inside escutcheon for increased security.
  - c. Offline – access control rights stored on device
    - 1) Visual tri-colored LED indicators that indicate activation, additional PIN code credential required, operational systems status, system error conditions and low power conditions.
    - 2) Visual bi-colored LED indicator on interior that is capable of indicating secured/unsecured status of device to occupants on interior.
    - 3) Onboard processor with memory capacity of 5,000 users, 5,000 event audit history, up to 16 time zones and up to 32 calendar events.
  - d. Networked – hardwire and wireless
    - 1) Ability to communicate unit's communication status.
    - 2) Visual tri-colored LED indicators that indicate activation, additional PIN code credential required, operational systems status, system error conditions and low power conditions.
    - 3) Visual bi-colored LED indicator on interior that is capable of indicating secured/unsecured status of device to occupants on interior.
7. Adaptability:
- a. Field changeable Reader Modules: Adaptable electronic access control products to have the ability to change credential reader technologies without being removed from door.
  - b. Offline
    - 1) Networking Capabilities: Network adaptable without removing device from door. Adaptable electronic access control products to have the ability to be upgraded in the field from a standalone battery powered configuration to a wireless networked configuration without being removed from the door.
  - c. Networked
    - 1) Open Architecture: Adaptable electronic access control products manufactured with open architecture characteristics capable of handling new and existing access control software and credential reading technology.
8. Switches: Provide adaptable electronic access control products with the following switches, standard:
- a. Door Position Switch
  - b. Interior Cover Tamper Guard
  - c. Mechanical Key Override
  - d. Request to Exit
  - e. Request to Enter
  - f. Lock/Unlock Status (Clutch Position).
9. Credential Reader:
- 1) in door hardware sets. Multi-tech contactless reader shall be NFC-Compatible and read access control data from both 125 kHz and 13.56 MHz contactless smart cards. The multi-tech contactless reader shall be optimally designed for use in access control applications that require reading both 125 kHz proximity and 13.56 MHz contactless smart cards.
    - a) Proximity, Smartcard via Multi-Technology.
    - b) Proximity, Smartcard via Multi-Technology and keypad.



- 2) Credential Reader Capabilities: Provide credential readers capable of being configured at lockset with handheld programming device and remotely operated with the following integrated software partners.
  - a) 13.56 MHz Smart card credentials:
    - i. Secure section (Multi-Technology and Smartcard): aptiQ MIFARE Classic, aptiq MIFARE DESFire EV1, PIV and PIV-I Compatible
    - ii. 13.56 MHz Serial number only (Multi-Technology and Smartcard): MIFARE, DESfire, HID iClass, MIFARE DESFire EV1
    - iii. 125 kHz Proximity card credentials: Schlage, XceedID, HID, GE/CASI ProxLite and AWID.
  - b) Dual credential reading capabilities credential card or fob and PIN.

10. Operation:

- a. Offline – access control rights stored on device
  - 1) Provide adaptable electronic access control products with the ability to be configured at door by handheld programming device the length of time device is unlocked upon access grant.
  - 2) Provide adaptable electronic access control products with the ability to communicate identifying information such as firmware versions, hardware versions, serial numbers, and manufacturing dates by handheld programming device.
- b. Networked – hardwired
  - 1) Adaptable electronic access control product system interface:
    - a) Directly via RS485.
  - 2) Adaptable electronic access control products to have real-time bidirectional communication between access control system and lock.
  - 3) Credential Verification Time: less than 1 second.
  - 4) When Utilized with Partner Integrated Access Control Network Software With Remote Commanding Capability: Provide adaptable electronic access control product with the ability to be remotely locked down or unlocked within 10 seconds or less, without user interface at the device.
  - 5) Upon Loss of Power to Device: Provide adaptable electronic access control product with the ability to manage access control offline in one of three methods below that can be configured in the field at lockset by handheld programming device and remotely by Partner integrated software:
    - a) Fail locked (secured)
    - b) Fail unlocked (unsecured)
    - c) Fail As-Is
  - 6) Upon Loss of Communication Between Device and Network: Provide adaptable electronic access control product with the ability to manage access control offline in one of four methods below that can be configured in the field at device by handheld programming device and remotely by Partner integrated software:
    - a) Fail locked (secured)
    - b) Fail unlocked (unsecured)
    - c) Fail As-Is
    - d) Fail to Degraded/cache mode utilizing cache memory with following selectable options:
      - i. Grant access up to the last 1,000 unique previously accepted User IDs.
      - ii. Grant access up to the last 1,000 unique previously accepted facility/site codes.
      - iii. Remove from cache previously stored User IDs or facility/site codes that have not been presented to lock within the last 5 days.
  - 7) Provide adaptable electronic access control product with the ability to be configured at door by handheld programming device and remotely by Partner integrated software the length of time device is unlocked upon access grant.

- 8) Provide adaptable electronic access control product with the ability to communicate identifying information such as firmware versions, hardware versions, serial numbers, and manufacturing dates by handheld programming device and remotely by Partner integrated software.

F. Components

1. Product: Schlage HHD series with Utility Software.
  - a. Provide Handheld Programming Device for adaptable electronic access control products capable of the following minimum requirements.
    - 1) Capable of initializing lock and accessories using preloaded software.
    - 2) Utilized to field configure electronic access control devices, to download firmware updates and door files to device, and to download audit files from device.
  - 3) Applicable Standards:
    - a) Listed, UL 294 - The Standard of Safety for Access Control System Units.
    - b) Compliant with NEMA 1, 4, 4X, 6; 294
    - c) Certified compliant with FCC Part 15 and RoHS.
  - 4) Power Supply: 12VDC or 24VDC.

G. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage MTB11/ MTB15.

H. Requirements: Read Only Multi-technology Contactless reader

1. Provide access control card readers manufactured by a global company who is a recognized leader in the production of access control devices. Card reader manufactured for non-access control applications are not acceptable
2. Provide multi-technology contactless readers which can read access control data from both 125 kHz and 13.56 MHz contactless smart cards and NFC-compatible. Provide multi-technology contactless reader optimally designed for use in access control applications that require reading both 125 kHz Proximity and 13.56 MHz contactless smart cards by providing:
  - a. Configuration allows reader to be enabled to read smart, proximity or both technologies at the same time.
  - b. A migration platform to upgrade from the most popular 125 kHz proximity technologies to MIFARE or MIFARE DESFire EV1 by reading both 125 kHz proximity technology and 13.56 MHz contactless smart card technology.

### **PART 3 EXECUTION**

#### **3.01 Installers**

- A. Contractor installation personnel shall be trained and certified by the SMS manufacturer and have a valid, current certification at the time of installation.
- B. Contractor installation personnel shall comply with all applicable state and local licensing requirements.

#### **3.02 Preparation**

- A. The network design and configuration shall be verified for compatibility and performance with the SMS.
- B. The network configuration shall be tested and qualified by the Contractor prior to system installation.
- C. Server performance parameters shall be compared with Manufacturer requirements for the SMS.

#### **3.03 Installation**

- A. Contractor shall follow manufacturer published installation and configuration instructions and guidelines.
- B. System shall be configured in accordance with manufacturer-supplied hardening guide. SMS systems for which the manufacturer does not provide a hardened installation option shall not be acceptable.
- C. Systems installed in a cloud environment shall be configured in accordance with manufacturer-supplied guidelines outlined in a cloud deployment guide. SMS systems for which the manufacturer does not provide a cloud deployment option shall not be acceptable.

#### **3.04 Storage**

- A. Server and system hardware devices and components shall be stored in an environment where temperature and humidity are in the range specified by the Manufacturer.

**END OF SECTION**

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## SECTION 28 16 00

### INTRUSION DETECTION SYSTEM

#### PART 1- GENERAL

##### 1.01 SCOPE

- A. The Contractor shall furnish and install a complete Intrusion Detection System. The Intrusion Detection system shall be microprocessor-based, network capable and complete with an integral DACT and a Network Interface Card. The intrusion detection system shall be capable of providing, at a minimum, the following:
1. Intrusion Detection Control Panel
    - a) Integral Digital Alarm Communications Transmitter (DACT).
    - b) Network Interface capability via the District Wide Area Network.
  2. Addressable initiation devices
  3. Addressable control modules
  4. Notification Appliances
  5. Remote Power Supplies
  6. On-site or remote video monitoring
  7. Temperature threshold detection and monitoring
  8. Humidity threshold detection and monitoring
  9. Pressure threshold detection and monitoring
  10. Power loss detection and monitoring, generator switching
  11. Leak detection and monitoring
  12. Carbon monoxide detection and monitoring
  13. Tank level threshold detection and monitoring
  14. Integral Card Access Control System
  15. Central Station Monitoring connection via AES-Intellinet Mesh Net Radio System
- B. The Contractor shall furnish all labor, materials, appliances, tools, equipment, facilities transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the applicable Contract Drawings and/or specified herein.
1. This specification document provides the requirements for the installation, programming, and configuration of a complete Command Processor Panel System. This system shall include, but not be limited to:
    - a) Control panel
    - b) System cabinet
    - c) Power supply
    - d) Single and multi-zone expansion modules
    - e) Addressable initiating bus (LX Bus)
    - f) Keypad Bus
    - g) Hard-wired zone cabling
    - h) Batteries
    - i) Conduit
      - 1) All required conduit and/or raceway shall be provided by the electrical contractor
    - j) Associated peripheral devices
    - k) Central Station Monitoring connection via AES-Intellinet Mesh Net Radio System
    - l) Other relevant components and accessories required to furnish and install a complete and operational system.
- C. Any material and/or equipment necessary for the proper operation of the system, which is not specified or described herein, shall be deemed part of this Specification.
- D. **By submission of a Prime Bid for this project, the Prime Bidder assumes complete and total responsibility for himself and his subcontractors'**

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**compliance with this specification in its entirety. If found to be not in compliance with any part of this specification, the Prime Bidder shall bear any burden, financial or otherwise, required to complete the work of this specification to the total satisfaction of La Canada Unified School District.**

1.02 QUALIFICATIONS

A. Equipment

1. **This specification is based on the equipment of the manufacturer who's equipment has been pre-approved by La Canada Unified School District for use in their facilities. Due to this fact, the herein named manufacturer's equipment shall be considered the District Standard for Intrusion Detection. No substitutions shall be accepted without District approval no less than 10 days prior to the bid opening.**
2. All equipment shall conform to applicable codes and ordinances.
3. All equipment shall bear the label of a Nationally Recognized Testing Laboratory (NRTL) such as Intertek Testing Services NA, Inc. (ITSNA - formerly ETL) or Underwriters Laboratories Inc. (UL) and be listed by their re-examination service.

B. System Supplier/Installer

1. The system shall be provided and installed by the Manufacturer's Authorized Distributor who is trained and certified by the Manufacturer in the proper installation, programming, service and maintenance of the system.
  - a) Upon demand, the bidding Prime Contractor shall provide the following qualification documentation for the System Supplier/Installer whether it be himself or his subcontractor regardless of tier. Failure to provide the documentation listed below upon demand by the District or its representative shall be cause for disqualification of the Prime Contractor's entire bid.
    - 1) The System Supplier/Installer shall provide proof of current status as the Manufacturer's Authorized Distributor in good standing.
    - 2) The System Supplier/Installer shall provide proof that a minimum of four (4) technicians have attended and completed all requirements and received certification from the manufacturer's installation and service school.
    - 3) The System Supplier/Installer shall provide proof that his company has been continuously engaged in the business of providing alarm systems on school projects in the Orange County area for a minimum of fifteen (15) years.
    - 4) System Supplier/Installer shall provide a list of ten (10) immediately verifiable LA or Orange County School District references complete with names and telephone numbers.
    - 5) System Supplier/Installer shall provide a list of twenty (20) on-going or completed projects of type indicated in the contract documents. Five of these shall be projects of similar size and scope to the project indicated in the bid documents and all must be immediately verifiable. For the purposes of this qualification, projects completed more than five years past shall not be acceptable.
    - 6) The System Supplier/Installer shall hold a valid State of California Contractor's License, C-10 and C7.
    - 7) The System Supplier/Installer shall hold a valid State of California Alarm Company Operator License, ACO.
    - 8) The System Supplier/Installer shall provide proof that they maintain a complete service and maintenance center within 50 miles of the project address. A complete service center shall include replacement parts in stock in the quantities deemed sufficient by the owner or its representatives.

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- 9) The System Supplier/Installer shall be a Factory Authorized Dealer for AES-Intellinet and shall provide 12 months of Central Station Monitoring, free of charge, as a part of this contract.
  - 10) The System Supplier/Installer shall be prepared to offer a service contract for the maintenance of the system beyond the warranty period.
- 1.03 RELATED SPECIFICATIONS
- A. The conditions of the General Contract (General, Supplementary, and other Conditions) and the Division 1 - General Requirements specifications are hereby made a part of this Section. All applicable portions of the following shall be a part of this section.
    - 1. Division 26
    - 2. Division 27
    - 3. Division 28
  - B. RELATED WORK BY OTHERS
    - 1. Reference Part 3, sub-section 3.01 of this specification.
- 1.04 APPLICABLE CODES & STANDARDS
- A. The intrusion detection/access control system shall comply with the applicable provisions of the currently adopted versions of the following codes and standards.
    - 1. Building Standards Administrative Code, Part 1, Title 24, California Code of Regulations
    - 2. California Building Code (CBC) Part 2, Title 24, California Code of Regulations (Uniform Building Code, Volumes 1, 2 & 3 with California Amendments)
    - 3. California Electrical Code (CEC) Part 3, Title 24, California Code of Regulations (National Electrical Code with 2001 California Amendments)
    - 4. California Fire Code (CFC) Part 9, Title 24, California Code of Regulations (Uniform Fire Code with California Amendments)
    - 5. National Fire Protection Association (NFPA) standards:
      - a) NFPA 70, National Electric Code
      - b) NFPA 110, Standard for Emergency and Standby Power Systems
      - c) NFPA 111, Standard on Stored Electrical Energy Emergency and Standby Power Systems
      - d) NFPA 780, Standard for the Installation of Lightning Protection Systems
  - B. ADA - Americans with Disabilities Act
  - C. CAC – California Administrative Code, Title 24
  - D. U.L. Standards
    - 1. The system shall comply with the applicable provisions of the following U.L. Standards:
      - a) UL 294, Standard for Access Control Systems Units
      - b) UL 609, Standard for Local Burglar Alarm Units and Systems
      - c) UL 634, Standard for Connectors and Switches for Use with Burglar-Alarm Systems
      - d) UL 636, Standard for Holdup Alarm Units and Systems
      - e) UL 639 Standard for Safety for Intrusion Detection Units
      - f) UL 681, Standard for the Installation and Classification of Burglar and Holdup Alarm Systems
      - g) UL 1076, Standard for Proprietary Burglar Alarm Units and Systems
      - h) UL 1610, Standard for Central Station Burglar Alarm Units
      - i) UL 1635, Standard for Digital Alarm Communicator System Units
      - j) UL 2044, Standard for Commercial Closed Circuit Television Equipment
- 1.05 SUBSTITUTIONS
- A. **No substitutions shall be accepted without District approval no less than 10 days prior to the bid opening.**
- 1.06 SUBMITTALS

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- A. Within thirty-five (35) calendar days after the date of the award of the contract, the Contractor shall submit to the Architect for review, eight (8) copies of a complete Submittal Package. The Submittal shall consist of the following sections, with each section separated with index tabs.
1. Title Page
    - a) Project Title
    - b) Project address
    - c) Architect's name and address
    - d) Contractor's name and address
  2. Index of Submittal Contents
    - a) Each Section of the Submittal Package shall be numbered chronologically and shall be summarized in the Index.
  3. Certifications
    - a) Index of Certification Section Contents
    - b) Valid State of California Contractors License
    - c) Manufacturer's Certifications
      - 1) Authorized Distributor
      - 2) Factory Trained Technician
  4. Project List
    - a) A substantial list (minimum of 20) of completed projects equal in scope to that specified herein.
      - 1) Contact information shall be made available upon request.
  5. Product Data
    - a) Index of Equipment Data Sheets
    - b) Manufacturer's Data Sheets including cable types
    - c) Applicable Listings and Approvals
  6. Shop Drawings
    - a) Shop Drawings shall not be required for this system on this project regardless of notes on the plans.

**PART 2– PRODUCTS**

**2.01 SYSTEM REQUIREMENTS**

- A. Component Enclosure
1. Housings; power supply enclosures, terminal cabinets, control units, and other component housings, collectively referred to as enclosures shall be so formed and assembled as to be sturdy and rigid. If sheet steel is used in the fabrication of enclosures, it shall be not less than an 18 gauge door with a 20 gauge box frame. Where exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent ready removal. Doors having a latch edge length of less than 24 inches shall be provided with a single lock keyed to the District Standard lock for Intrusion Detection/Access Control Cabinets
- B. Electronic Components
1. All system electronic components shall be solid-state type, mounted on printed circuit boards. Light duty relays and similar switching devices shall be solid-state type or electromechanical.
  2. The panel shall have an over-current notification LED that lights when devices connected to the Keypad Bus and LX-Bus(es) draw more current than for which the panel is rated. When the over-current LED lights, the LX-Bus (es) and Keypad bus are shut down.
- C. Control Unit
1. The networked control panel shall provide the following capabilities:
    - a) Expansion to a total of at least 10,000 user codes with 99 user profile definitions.
    - b) Sixteen (99) independent door/keypad addresses, each with four zones.
    - c) Twenty (20) Holiday Dates for custom holiday scheduling by area.

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- d) A total door access granted event buffer of at least 10,000 events.
  - e) Anti-passback access control selectable by area and user.
  - f) Four (4) shift schedules per area.
  - g) A total of at least 100 programmable output relay schedules.
  - h) Thirty-two (32) individual reporting areas.
  - i) Built-in bell and telephone line supervision.
  - j) Require two-man access code or credentials.
  - k) Support programming to require the same or different access code entered within a programmed delay time of 1 to 15 minutes after disarming before activating a silent ambush alarm.
  - l) Support area programming that disables schedule and time-of-day changes while system is armed so that area can only be disarmed during scheduled times.
2. Control unit shall be capable of operating and supervising notification appliance devices as well as addressable initiating detection devices and an integrated supervised dual line digital communicator.
  3. Control unit must be "Flash ROM" updatable, and program must be held in non-volatile RAM. The panel shall be able to function while the update is in process.
  4. Control unit shall be capable of sending information to and receiving instructions from the existing District Wide Security Management Software via the District's Wide Area Network (WAN).
  5. Control unit shall be capable of operating using an optional built in Encrypted Alarm Router for SCIF (Sensitive Compartmented Information Facility) applications that is certified by NIST (National Institute of Standards and Technology) for 128 Bit AES Rijndael Encryption communications.
  6. The optional built-in Encrypted Alarm Router shall be capable of compliance with DCID 6/9 and UL 2050 standards.
- D. Control Designations
1. Controls shall be provided to ensure ease of operation of all specified characteristics. Where applicable, clockwise rotation of controls shall result in an increasing function. Controls, switches, visual signals and indicating devices, input and output connectors, terminals and test points shall be clearly marked or labeled on the hardware to permit quick identification of intended use and location.
- E. Test Modes
1. The system shall include a provision that permits testing from any alphanumeric keypad. The test shall include standby battery, alarm bell or siren, and communication to the District.
  2. The system shall include a provision for an automatic, daily, weekly, thirty (30) day, or up to sixty (60) day telephone communication link test from the control panel installation site to the central station. The system shall also have the capability of testing the network communication path every four minutes.
  3. The system shall include a provision for displaying the internal system power and wiring conditions. Internal monitors shall include the bell circuit, AC power, battery voltage level, charging voltage, panel box tamper, phone trouble line 1, phone trouble line 2, transmit trouble, and network trouble.
- F. Serial Interface
1. The control panel shall be capable of a serial interface to output information to a standard serial printer or serial interface to a communication port on a standard computer. Through control panel programming the system shall include a provision to allow the selection of which reports are to be output.
- G. Power Supplies
1. Power supplies for the control unit shall operate from 120 VAC, supplied at the respective protected areas. Standby batteries shall be supplied to power the system in the event of a utility power failure. Batteries shall be sized to provide



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105% capacity for eight hours. Standby batteries shall be sealed lead-acid. Power supplies shall be all Solid State.

2. Controls shall be designed to maintain full battery charge when alternating current is available. Batteries shall be recharged to 85% capacity within 24 hours from battery use. The system shall be automatically transferred to battery power upon loss of alternating current power and return to alternating current power upon restoration. Intrusion alarms shall not be initiated during switch over; a signal shall be initiated upon failure of battery or alternating current power.
3. Approved power supplies shall meet or exceed the following power supply model specifications:
  - a) UL Listed DMP 505-12: 12VDC 5 amp with transformer and enclosure.
  - b) UL Listed DMP 504-24: 24 VDC 4 amps with transformer and enclosure.

#### H. Software

1. The system shall have the capability to interface with computer software with the capability to fully program the panel by connecting to the panel through:
  - a) Direct cable connection interface card
  - b) Receiver phone line connection
  - c) Standard phone line connection
  - d) Ethernet network connection
  - e) Network connection across the Internet or Wide Area Network (WAN).
2. The system shall interface with the existing District Wide Security Management Software via the District Wide Area Network (WAN).
3. The system shall interface with computer software capable of exporting reports in the following file formats:
  - a) Excel spreadsheet (\*.xls)
  - b) Rich Text (\*.rtf)
  - c) Windows Metafile (\*.wmf)
  - d) QuickReport (\*.qrp)
  - e) Text (\*.txt)
  - f) Comma-separated (\*.csv)
  - g) HTML document (\*.htm)
4. The system shall interface with computer software capable of printing custom, filtered reports including:
  - a) All Events
  - b) Zone Action
  - c) Arming/Disarming
  - d) Area Late to Close
  - e) User Code Changes
  - f) Door Access Granted
  - g) Door Access Denied
  - h) Opening/Closing Schedule Changes
  - i) System Monitors
  - j) System Events
  - k) Event Acknowledgement

#### I. INTEGRATED INTRUSION DETECTION AND ACCESS CONTROL OPERATION

1. Access Authority Levels
  - a) The system shall be capable of programming access credentials authority levels to check whether the user has access to a specific area and also has the authority to disarm or arm the area. If the user access credential has access and disarm/arm authority the system shall provide the user the option to disarm the area simultaneously upon opening the door, or to open the door and begin an entry delay timer. With the timer option the user then disarms the area using an intrusion control keypad inside the area. If the user only has access authority to the area and the area is in an armed condition, the user is denied access to the area.

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2. Door Open Schedule Override
  - a) The system shall be capable of programming certain area doors to be scheduled to unlock and lock at specific times of the day or night. The lock/unlock function shall be capable of an override option depending upon the area armed/disarmed status. If the area remains in an armed status at the scheduled unlock time the armed status overrides the unlock schedule ensuring the doors remain locked and armed in situations where the business might open late, close early, is affected by inclement weather, or another emergency.
3. Common Area
  - a) The system shall be capable of programming a common area to be armed when the last area in the system is armed and disarmed when the first area in the system is disarmed. To ensure the common area works properly it shall not have any user codes assigned to the common area. The system shall also be capable of programming multiple common areas.
4. Early Morning Ambush
  - a) The system shall be capable of programming an area to require two user codes be entered within a programmed number of minutes to prevent an ambush message from being sent to the Central Station Receiver. If both user codes are not entered within the time an ambush message is sent to the central station receiver.
  - b) Both user codes shall have the authority to disarm the specific area and must be entered at the same keypad or reader. The keypad shall not display any indication that the ambush timer is running.
  - c) The system shall be capable of programming an output to provide an external indicator that an ambush situation is taking place.
5. Two-Man Rule
  - a) The system shall be capable of programming an area to require two separate user codes be entered in order to disarm and/or allow access to a specific area. Both required codes shall have at least the same or greater authority level. Both required codes shall be entered within 30 seconds or an alarm shall activate.
6. UL Bank Safe & Vault Operation
  - a) The system shall be capable of being programmed to only be disarmed during scheduled times regardless of the authority level of any user code or user profile in the system. The schedule and time and date set for this area shall not be capable of being changed while the area is armed. Zones assigned to Bank Safe & Vault areas shall not be able to be bypassed or force armed.
7. Panic Button Summary Test
  - a) The system shall have the ability to test panic buttons without sending a panic alarm to the Central Station Receiver.
  - b) The system shall also have the ability to send panic zone test verification and failure results to the Central Station Receiver.
  - c) During the test, each time a panic zone trips, the display number shall increment and the keypad buzzer sound for two seconds.
  - d) The number of panic zones tripped shall constantly display until the test ends or no panic zone activity has occurred for 20 minutes.
  - e) When the Panic Zone Test ends and a zone failed (did not trip) during the test, the keypad shall be able to display the zone name and number and have the buzzer sounds for one second. Additional zone failed zones shall display when a button is pressed.
- J. FALSE ALARM REDUCTION FEATURES
  1. The system shall be capable of providing false alarm reduction features, functions, capabilities, or processes that either require alarms be verified or

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- potential alarms be corrected before a system or zone can be placed into an armed state.
2. Exit Error Alert and Reporting
    - a) The panel shall be able to provide an automatic function to prevent a false alarm from occurring if an exit door does not properly close after the system is armed.
  3. Entry and Exit Delay Annunciation
    - a) When arming, the system shall provide clear annunciation indicators to the user about the need to exit the premises prior to the exit delay time expiring.
    - b) When disarming, the system shall notify the user the need to disarm the system prior to the entry delay time expiring.
  4. Remote Annunciation
    - a) The system shall be able to provide entry and exit delay time period notification. This notification can be from DMP keypads, remote annunciators, or bell tests.
  5. Abort Reporting
    - a) The system shall be capable of sending an Abort report to the central station if the system is disarmed while the alarm is still sounding. The Abort report shall be sent *after* the alarm report to notify the central station that an authorized user has cancelled the alarm.
  6. System Testing
    - a) The system shall offer testing features that are simple, quick, and complete and provide the highest measure of safety by ensuring that alarm conditions are detected and communicated to the proper authorities in a timely manner and on a regularly scheduled basis.
  7. Ambush Code
    - a) The system shall offer ambush codes for those dangerous encounters where the user is instructed to either arm or disarm the system under threat of harm. The duress code shall disarm the system without giving local indication of an alarm that might put the user well-being in jeopardy.
  8. Two-Button Panic Feature
    - a) The system shall support DMP keypads that provide the option to use only two-button panic codes. The user shall be required to press and hold two designated keys for approximately two seconds before the system generates a panic alarm.
  9. Fire Verify Zones
    - a) The system shall support Fire Verify zones to help the panel verify the existence of an actual fire condition before it sends an alarm report to the central station. The Fire Verify zone shall require the panel to perform a Sensor Reset whenever a device connected to a Fire Verify zone initiates an alarm. This shall begin a verification period during which the panel waits for a second alarm initiation. If the original zone or any other Fire Verify zone on the panel initiates an alarm within the next 120 seconds, the panel shall recognize this as an actual alarm and send an alarm report to the central station.
  10. Cross-Zoning Protection
    - a) The system shall support cross-zoning as a means of requiring two device trips to occur within a short period of time before sounding an alarm and sending an alarm report to the central station. Supported device trips shall be from one device that trips two times, or from two devices that each trip once.
  11. Swinger Zone Bypassing
    - a) The system shall be capable of automatically bypassing a zone if it goes into an alarm or trouble condition a specified number of times within a one-

hour period. The panel shall be able to track the number of times the zone trips while armed and compare that against a programmed number. When that number is reached, the panel shall be able to automatically bypass the zone. The panel shall be capable of resetting the zone when the area to which it is assigned disarms, is manually reset from the keypad or remotely, or remains normal for one hour.

12. Recently Armed Report

- a) The system shall be capable sending a System Recently Armed report, along with a zone alarm report, to the central station any time an alarm occurs within five minutes of the system arming. The System Recently Armed report allows the central station operator to follow a "call the subscriber first" procedure instead of immediately dispatching the police to what could be a false alarm.

13. Transmit Delay

- a) The system shall be capable of programming the panel to wait up to 60 seconds before sending burglary alarm reports to the central station. If an alarm is accidental, the user shall be able to disarm the system within the programmed Transmit Delay time. An Abort report shall be sent in place of an alarm report after the system disarms. During the alarm, sirens and panel relay outputs shall not be delayed and shall still provide local condition annunciation.

14. Call Waiting Cancel

- a) The system shall be capable of being programmed to cancel call waiting any time the panel dials the receiver number to send a report.

2.02 SYSTEM CAPABILITIES

A. System Description

1. The system user shall be capable of selectively arming and disarming any one or more of 32 areas within the intrusion detection system based on the user PIN code and/or keypad used. Each of the 574 zones shall be able to be assigned to any of the 32 available areas. The system shall be capable of having up to a sixteen (16) character length name programmed for each area.
2. The system user shall be capable of assigning an opening and closing schedule to all areas or to each of the 32 areas separately. Each area shall be able to arm or disarm automatically by a schedule. The system shall have the capacity for common areas that automatically disarm when any other area disarms and that automatically arm when all others areas arm.
3. The networked system shall have the ability to comply with Bank Safe & Vault application. The networked system shall also have the ability to use a two-man rule for disarming or allowing door access to an area. The system shall have the ability to operate a Common Area application.
4. The system shall have a minimum of eight (8) grounded burglary zones available from the control panel.
5. The system areas and zones shall be programmable, and the system shall store, log, display, and transmit specific custom designations for system areas, zones, and user names.
6. To ensure continued, one-call support, the system shall be constructed of sensing components provided directly by the system manufacturer, such as power supplies, motion detectors, door and window position switches, glass break detectors, or other sensing devices that the manufacturer offers.
7. The system controller, user interfaces, zone input devices, relay output devices, and the system signal receiving equipment shall be engineered, manufactured, assembled, and must be distributed from a location within the United States of America.

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8. The system shall support user interaction by way of a keypad, web browser, system software, key switch, or radio frequency wireless control, using integrated or auxiliary devices provided by the system manufacturer.
  9. The system shall support controller zone input connections, system keypads, system zone expansion modules, and wireless zone input modules, and must support zone input connections by way of at least two competitive products. The system shall offer a seamless integrated compatibility with hard-wire and/ or wireless zone expansion equipment for at least 200 wireless zones and/ or a maximum of 574 hardwired zones.
  10. The system shall be capable of offering at least five zone expansion buses, each of which can support the connection of up to 15,000 feet of four-wire cable. Zone expansion and keypad data buses that exceed 2,500 feet of cable must include splitter/repeater modules to boost data voltage and maintain data integrity.
  11. The system shall provide a seamless capability to provide a minimum of 500 addressable relays, which can be located at any connection location upon a zone expansion bus.
  12. System relay outputs shall have the capability of being triggered as a result of a command from the user interface, changes in system status, changes in zone status, or by a programmable schedule.
  13. System relay output states shall be programmable for momentary, maintained, pulsed, or must follow the state of an associated system zone input.
  14. The system shall be completely programmable either locally from a keypad or remotely through a standard dial-up, and network connections by way of a LAN, WAN, and/or by way of the Internet.
  15. The control unit shall be completely programmable remotely using remote annunciators, and/ or using upload/ download software that communicates using SDLC 300 baud, 2400 baud, or IP Addressed data network. On-site programming from a personal computer shall also be permitted.
  16. The control unit shall be equipped with an anti-reversing circuit breaker to prevent damage due to accidental reversal of battery leads.
- B. Input/Output Capacity
1. This system shall be capable of monitoring a maximum of 574 individual zones and controlling a maximum of 502 output relays.
  2. The control panel shall have, as an integral part of the assembly, 2 SPDT Form C relays rated at 1 Amp at 30 VDC and four open collector 12 VDC outputs rated at 50mA each. It shall also have the capacity of a maximum of 125 output expander modules with 500 switched ground, open collector outputs, 50mA maximum and 502 auxiliary relays (Form C rated at 1.0 Amp at 30 VDC).
  3. The panel shall also provide 100 programmable output schedules, and include an integral bell alarm circuit providing at least 1.5 Amps of steady, pulsed, or temporal bell output. Output type shall be programmable by zone type. Relays and voltage outputs shall be capable of being independently programmed to turn on and/or off at selected times each day.
- C. User/Authorization Level Capacity
1. The system shall be capable of operation by 10,000 unique Personal Identification Number (PIN) codes with each code having one (1) of ninety-nine (99) custom user profiles. This allows for limitation of certain functions to authorized users. The operation of all keypads shall be limited to authorized users.
- D. Keypads
1. The system shall support a maximum of sixteen (16) keypads with alphanumeric display. Each keypad shall be capable of arming and disarming any system area based on a pass code or Proximity key authorization. The keypad alphanumeric display shall provide complete prompt messages during all stages of operation and system programming and display all relevant operating and test data.

2. Communication between the control panel and all keypads and zone expanders shall be multiplexed over a non-shielded multi-conductor cable, as recommended by the manufacturer. This cable shall also provide the power to all keypads, zone expanders, output expanders, and other power consuming detection devices.
  3. If at any time a keypad does not detect polling, the alphanumeric display shall indicate "SYSTEM TROUBLE". If at any time two devices are programmed for the same address, the alphanumeric keypad shall display "4 WIRE BUS TROUBLE". If at any time a keypad detects polling but not for its particular address, the alphanumeric display shall indicate "NON POLLED ADDR". The system shall display all system troubles at selected keypads with distinct alphanumeric messages.
  4. The keypad shall include self-test diagnostics enabling the installer to test all keypad functions: display test, key test, zone test, LED test, relay test, tone test, and address test.
  5. The keypad shall provide an easy-to-read English text display. The text shall exactly match the text seen in all software reports, keypad displays, and central station reports.
  6. The keypad user interface shall be a simple-to-use, menu-driven help system that is completely user friendly.
  7. The control panel shall support a keypad interface accessible on the World Wide Web in a browser window. The web-accessible keypad interface shall provide at least five (5) programmable hyperlinks for camera access or other use.
  8. The system shall support sub-control keypads with four (4) built-in zones and capable of functioning in the following modes:
    - a) Panel monitors all four (4) keypad zones independently with a maximum of 125 keypads attached to the control panel
    - b) Panel assigns one (1) zone to each keypad and monitors all keypad zones as a single zone with a maximum of 500 keypads attached to the control panel
    - c) Stand-alone mode allowing keypad to operate as a self-contained security system independent of the control panel
- E. Zone Configuration
1. A minimum of 4 Class B ungrounded zones shall be available at each keypad or zone expander on the system. The system shall have the capacity for a maximum of sixteen (16) keypads and a maximum of 125 four (4) zone expanders or 500 single zone expanders. It shall also have the capacity of a maximum of 125 supervised relay output expanders.
  2. Each zone shall function in any of the following configurations: Night, Day, Exit, Fire, Supervisory, Emergency, Panic, Auxiliary 1, Auxiliary 2, Fire Verification, Cross Zone, Priority, and Key Switch Arming.
  3. The LX bus and the keypad bus shall be able to operate at a maximum wiring distance of 2500 feet from the control panel on unshielded, non-twisted cable. This distance may be extended to a total of 15,000 feet when bus splitter/repeater modules are installed.
  4. The system shall have the capability to incorporate up to 500 addressable zone expander points.
  5. Each zone shall function in any of the following configurations:
    - a) Night
    - b) Day
    - c) Exit
    - d) Fire
    - e) Supervisory
    - f) Emergency
    - g) Panic

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- h) Auxiliary 1
- i) Auxiliary 2
- j) Fire Verification
- k) Cross-Zone
- l) Priority
- m) Arming

F. Communication

1. The system shall be capable of signaling to two remote monitoring station receivers, four telephone numbers of 32 digits each using two separate switched telephone network lines such that if two unsuccessful attempts are made on the first line to the first number, the system shall make two attempts on first line to the second number. If these two attempts are unsuccessful, the system shall make two further attempts on the first line of the first number. After the tenth unsuccessful attempt, dialing shall stop and the alphanumeric keypad shall display trouble. Should another event occur that requires a report to be transmitted, the dialing process shall be repeated. The system shall have a programmable option to dial a second set of telephone numbers after the first ten attempts using the same sequence.
2. The system shall be capable of communication using the IBM Synchronous Data Link Control format, and at least two other standard industry formats.
3. The system shall be capable of supporting Network communication with digital dialer backup, existing Ethernet or token ring data networks, satellite communication, fiber optic networks, local area networks, wide area networks, cellular communication, and retail data networks.

G. Network Communication

1. The control panel shall be capable of asynchronous network communication with a retry time between 3 and 15 seconds for a total of one (1) minute. If communication is unsuccessful the control panel shall be capable of attempting backup communication through any of the available communication methods to the same receiver or a backup receiver.
2. Network communication between the control panel and the receiver shall be in a proprietary communication format.
3. The control panel shall be capable of supporting Dynamic Host Communication Protocol (DHCP) Internet Protocol (IP) addressing.
4. Underwriters Laboratories (UL) shall list network communication by the control panel for Grade AA High-Line Security.
5. The control panel shall be capable of two-way network communication using standard Ethernet 10BaseT in a LAN, WAN, or Internet configuration.
6. The control panel shall be capable of communication by means of a 128 Bit AES Rijndael Encryption process certified by NIST (National Institute of Standards and Technology) to an SCS-1R receiver with a built-in Encryption Alarm Router.
7. The control panel shall be capable of meeting DCID 6/9 and UL 2050 standards.

H. TCP/IP Network Trapping

1. The control panel shall be capable of having communication set to Network operation. When a trap is set in Remote Link, the software shall be capable of sending a panel trap message with the panel account number to the iCOM or iCOM-E installed in an SCS-1R receiver.
2. The receiver iCOM or iCOM-E shall store the trap and monitor the panel for the next message. When the panel sends its next message, the receiver iCOM or iCOM-E shall then send a message to the panel to contact Remote Link at the IP address contained in the original trap message.
3. The trap message shall be stored in the receiver iCOM or iCOM-E for up to four hours. If the trap message is not sent to the panel within the four-hour window, the panel trap message shall be discarded and a new trap message must be sent from Remote Link.

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4. The user shall be able to view the trap status in the receiver iCOM or iCOM-E in Remote Link using the Trap Query function.
- I. NAC Circuit Configuration
  1. The system shall be capable of additional Class B NAC circuits utilizing the Model 867 Notification Module. Each module shall be controlled and supervised via the SLC loop and monitor for short circuits, open circuits, and ground faults. The NAC circuits shall monitor for external NAC trouble conditions.
  2. The system shall be capable of providing Class A NAC circuits utilizing the Model 865 Notification Module. Each module shall monitor for short circuits, open circuits, and ground faults. The NAC circuits shall monitor for external NAC trouble conditions and have a manual bell silence switch.

## 2.03 SYSTEM COMPONENTS

- A. Head End Equipment
  1. Intrusion Detection/Access Control Panel
    - a) **DMP - Model No. XR550NL-G**
      - 1) Complete with large enclosure
      - 2) Complete with Dialer
      - 3) Quantity of (1) one required.
  2. Mesh Net Radio
    - a) **AES-Intellinet - Model No. 7058E-P**
      - 1) Quantity of (1) one required
      - 2) The Mesh Net Radio shall be configured to match the frequency currently being utilized by La Canada Unified School District.
        - (a) The current provider for Central Station Monitoring for La Canada Unified School District is R. M. Systems, Inc. of Placentia, California (714) 984-1206. The AES-Intellinet Radio and Central Station Monitoring for this project shall be procured through R. M. Systems, Inc.
- B. LCD Keypad
  1. **DMP – Thinline Series Model No. 7063-W**
    - a) 32-character alphanumeric LCD display with blue backlit keyboard, self-diagnostic, three 2-button panics, supervised or unsupervised operation, alert sounder, armed and AC LED.
    - b) Keypad shall be complete with an integral proximity reader.
    - c) The intrusion detection system shall be designed to include a predetermined time delay between entry and alarm. Operation of the keypad shall abort the alarm condition and disable the system until re-armed.
    - d) During an alarm condition, the alphanumeric readout on the keypad shall indicate, by room name and number, the location of the alarm and the keyboard turns red.
    - e) Quantity as indicated on plans
- C. Remote Power Supplies
  1. **Altronix – Model No. SMP3 or SMP5**
    - a) Power supply for passive infrared detectors, 12VDC provide one in each building. Provide power supply, terminal cabinet, transformer and battery as required for a complete and operable system.
      - 1) Terminal cabinet enclosure
        - (a) **DMP – Model No. 350-G or equal**
      - 2) Transformer 120VAC-12VDC
        - (a) **DMP - Model No. 321**
      - 3) Battery
        - (a) **Yuasa – Model No. NP7-12 or equal**
- D. Data Bus Splitter/Repeater
  1. **DMP – Model No. 710**



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- a) Expands the typical LX-Bus installation number of devices and the length of the wire.
  - b) Quantity as required.
- E. Single Point Zone Expander
  - 1. **DMP - Model No. 711 – Single Point Zone Expander**
    - a) The single point zone expander module provides a single addressable point and serves as the interface between the 4-wire LX Bus from the control panel and the conventional initiation devices (i.e. motion sensors and door switches).
- F. Multi-Point Zone Expander
  - 1. **DMP – Model No. 714 - four-point Zone Expander**
    - a) The four-point zone expander module provides four addressable points and serves as the interface between the 4-wire LX Bus from the control panel and the conventional initiation devices (i.e. motion sensors and door switches).
  - 2. **DMP – Model No. 714-8 - Eight-point Zone Expander**
    - a) The eight-point zone expander module provides eight addressable points and serves as the interface between the 4-wire LX Bus from the control panel and the conventional initiation devices (i.e. motion sensors and door switches).
  - 3. **DMP – Model No. 714-16 - Sixteen-point Zone Expander**
    - a) The sixteen-point zone expander module provides eight addressable points and serves as the interface between the 4-wire LX Bus from the control panel and the conventional initiation devices (i.e. motion sensors and door switches).
- G. Door Controller Module
  - 1. **DMP – Model No. 734 – Wiegand Interface Module**
- H. Motion Sensors – Triple Technology
  - 1. **Bosch – Model No. DS950**
    - a) Surface wall mount (PIR) passive infrared/microwave motion sensor
    - b) 50' coverage pattern
    - c) Locate motion sensors for optimum coverage per manufacturer's recommendation.
    - d) Connect to LX Bus via zone expansion module
  - 2. **Bosch – Model No. DS970**
    - a) Surface wall mount (PIR) passive infrared/microwave motion sensor
    - b) 70' coverage pattern
    - c) Locate motion sensors for optimum coverage per manufacturer's recommendation.
    - d) Connect to LX Bus via zone expansion module
- I. Magnetic Door Contact
  - 1. **Interlogix – Model No. 1078N**
    - a) Recessed mounted Steel Door Contact with wire leads, white
  - 2. **Interlogix – Model No. 2505A-L**
    - a) Surface mounted Wide Gap Door Contact with armored cable leads
- J. Electronic Door Lock
  - 1. **Schlage Model No. AD-300 Series**
    - a) Provide Schlage PIB300 Panel Interface Board for interface to DMP Wiegand Module.
- K. Siren
  - 1. **ATW Security – Model No. DS-301SET**
    - a) 25 watt siren in indoor/outdoor stainless steel enclosure.
    - b) Sirens shall be provided only if indicated on plans.
- L. Wire/Cable
  - 1. Interior Device and LX/Keypad Bus Cable

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- a) **Falcon Wire - Model No. 590422R or equal**
  - 1) 22/4-conductor solid CMR with white jacket
- 2. Underground LX Bus/Keypad Bus Cable
  - a) **Falcon Wire - Model No. 400418H20 or equal**
    - 1) 18/4-conductor stranded FPL with black jacket
    - 2) Water-blocked cable construction

**PART 3- EXECUTION**

3.01 DIVISION OF WORK

- A. While all work included under this specification is the complete responsibility of the contractor, the division of actual work listed following shall occur.
  - 1. All conduits with pull cords, all electrical pull boxes, grounding rods, all outlet boxes, terminal cabinets, backboards, etc., which form part of the rough-in work shall be provided and installed completely by the Division 16 Contractor. Coordinate as necessary for proper installation.
  - 2. The system, including installation of initiating devices, notification appliances and equipment, making all connections, etc., shall be performed by the Factory Trained Technicians of the System Supplier/Installer.
  - 3. All 120VAC power conductors and conduits associated with power circuits to all low voltage system equipment locations shall be provided and installed by the Division 16 Contractor.
  - 4. System grounding, in compliance with CEC Article 250, by the Division 16 Contractor.
  - 5. Labeling of pullboxes and terminal cabinets shall be provided and installed by the Division 16 Contractor.

3.02 INSTALLATION

- A. All work shall be completed in strict accordance with all applicable codes and ordinances, by a qualified Manufacturer's Authorized Distributor.
- B. Cable/Wire
  - 1. All cable/wire for the system specified herein shall be new, unless otherwise noted on plans.
  - 2. System cable/wire and equipment installation shall be in accordance with good engineering practices as established by the California Electrical Code (CEC). Wiring shall meet all applicable electrical codes. All cable/wire shall test free from all grounds and shorts.
  - 3. All cable/wire shall be labeled at all points of termination. All labeling shall be based on the room numbers as provided by the District or its representative.
  - 4. Protection and dressing of cables:
    - a) Cables mounted on backboards and within equipment racks, etc., shall be grouped and securely attached to the backboard or enclosure in horizontal and vertical bundles in a neat workmanlike manner using Thomas & Betts "Ty-Rap", Panduit cable mounts and Allen-Tel cable management or equal. Edge protection material ("cat-track") shall be installed on edges of holes, lips of ducts or any other point where cables or harnesses cross metallic edge.
  - 5. Shielding:
    - a) **Shielded cable shall not be utilized for this system. No exceptions.**
  - 6. Underground cables
    - a) Any cable/wire pulled through manholes or pullboxes located below grade, shall be continuous with no splices. The cable/wire shall be intact with no cuts in the protective outer jacket. The cable/wire shall be suitable for this application.

3.03 SYSTEM START-UP

- A. All start-up programming and system commissioning shall be performed by a manufacturer's trained and certified technician.

3.04 SYSTEM VERIFICATION

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- A. Subsequent to system start-up the system installer shall perform a pre-test to verify that the following features are functioning properly.
  - 1. All initiation devices
  - 2. All monitor modules
  - 3. Local audible devices
  - 4. Network connection and communication link to monitoring service
- 3.05 ACCEPTANCE TESTING
  - A. The system installer shall, in the presence of the Inspector of Record (IOR), perform 100% testing as noted in System Verification above.
- 3.06 IN SERVICE TRAINING
  - A. The Contractor shall instruct personnel designated by the District in the proper use, basic care and maintenance of the system beyond the warranty period. Contractor shall provide up to four hours of in-service training with this system.
- 3.07 FACTORY TRAINING & CERTIFICATION
  - A. The manufacturer shall provide factory certified training to two (2) technicians from the District. These technicians shall be trained and certified as manufacturers certified technicians capable of performing any work on the system after the installation of the system.
  - B. All cost for training including travel, lodging, meals and per diem shall be included in the System Supplier/Installer's bid for this project.
- 3.08 RECORD DRAWINGS AND CLOSE-OUT DOCUMENTATION
  - A. System supplier/installer shall periodically update the General Contractor's master set of record drawings kept on site.
  - B. Contractor shall provide the following at close-out.
    - 1. One electronic (PDF) copy of system record drawings.
    - 2. Three (3) wet signed copies of equipment warranty.
- 3.09 WARRANTY
  - A. The Contractor shall warrant the equipment to be new and free from defects in material and workmanship, and will, within one year from the date of installation, repair or replace any equipment found to be defective. This warranty shall not apply to any equipment that has been subject to misuse, abuse, negligence or unauthorized modification.

**END OF SECTION**

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**SECTION 28 20 00**

**VIDEO SURVEILLANCE SYSTEM (VSS)**

**PART 1 GENERAL**

**1.1 RELATED WORK**

- A. The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.
  - 1. Conditions of the Contract
  - 2. Division 1
  - 3. Division 26
  - 4. Division 27
  - 5. Division 28

**1.2 GENERAL PRODUCT REQUIREMENTS**

- A. The software used shall be designed for enterprise level use, with an expected use period of 24/7. It shall be the Manufacturer's official software.
- B. The software shall incorporate open standards and published protocols and use standardized components.
- C. The Video Management System provider shall be defined as the provider of the video management software, and the party responsible for rigorous self-testing of the video management software prior to the release of the software.

**1.3 GENERAL SYSTEM DESCRIPTION**

- A. The Video Management System shall support both centralized and decentralized configurations as well as hybrid options for architecture. Centralized management shall be available no matter the surveillance architecture. The system shall allow for integration with other security devices and products and be designed to allow for leveraging of those products to improve the user experience of the VMS.
- B. The VMS shall not require a central management server.
- C. The VMS shall make the user experience seamless to the end user irrespective of the system architecture.
- D. The VMS must be capable of each server being able to handle an unlimited number of cameras for recording.
- E. The VMS must support Windows Server 2008, 2012, and Windows Server 2016 for the server side. Client- side software must be available for Windows 7, 8 and 10, Mac OSX, iOS 6 and above, and Android. The operating system shall have all current and available patches.
- F. The VMS shall include the following without additional license fees:
  - 1. Client software for Windows.
  - 2. Client software for Mac OSX.
  - 3. Client software for iOS 6 and above.
  - 4. Client software for Android-based platforms.
  - 5. Client software using a web-based interface.
  - 6. Standalone clients designed to provide fixed displays.
  - 7. Video Wall functionality.
  - 8. SmartSearch.
  - 9. Access Control Integration.
  - 10. Full Access Control software platform.
  - 11. Failover server functionality.
  - 12. A separate health monitor application.

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- G. The VMS shall not require a separate application for administration and user-based roles. Limitations for non-administrative users shall be handled via permissions.
- H. The system shall support running in Virtual Servers for both the server application and client applications

1.4 SECTION INCLUDES

- A. Video Management Systems:
  - 1. Server application.
  - 2. Desktop application.
  - 3. Mobile application.
- B. Servers:
  - 1. Rackmount.
    - a. Servers will be provided, installed, and programmed by the system installer.
    - b. Server sizes and quantities shall be based on the needs to meet the requirements established by, but not limited to the following:
      - 1) Bandwidth
      - 2) Camera resolution
      - 3) Client workstation access
      - 4) Frame rates
      - 5) Video Compression
      - 6) Motion based recording
      - 7) Maximum of sixty-four (64) views per server
      - 8) Days of Retention
    - c. Provide a minimum of one server per site
- C. IP security cameras.
- D. VMS software licenses.
- E. Encoders and decoders.
- F. Controller systems.
- G. Accessory products.

1.5 REFERENCES

- A. Code of Federal Regulations (CFR).
- B. Institute of Electrical and Electronics Engineers (IEEE):
  - 1. 802.3 Ethernet Standards.
- C. International Electrotechnical Commission (IEC).
- D. International Organization for Standardization (ISO):
  - 1. ISO / IEC 10918 - Information technology -- Digital compression and coding of continuous-tone still images: Requirements and guidelines; JPEG.
  - 2. ISO / IEC 14496-10 - Information Technology - Coding Of Audio-Visual Objects - Part 10: Advanced Video Coding; MPEG-4 Part 10 ( ITU H.264).

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3. ISO / IEC 23008-2 - High Efficiency Coding and Media Delivery In Heterogeneous Environments - Part 2: High Efficiency Video Coding; MPEG-H Part2 (ITU H.265, HEVC).

E. Federal Communications Commission (FCC):

1. FCC Rules and Regulation of Title 47 of CFR Part 15 Subpart B Class A.

F. Open Network Video Interface Forum (ONVIF):

1. ONVIF - Profiles S Specification.

G. Underwriters Laboratories (UL):

1. UL listed.

## 1.6 DEFINITIONS

A. Abbreviations:

1. ARP - Address Resolution Protocol.
2. DHCP - Dynamic Host Configuration Protocol.
3. DNR - Digital Noise Reduction.
4. DDNS - Dynamic Domain Name Server.
5. FPS - Frames Per Second.
6. GUI - Graphical User Interface.
7. HDD - Hard Disk Drive.
8. HTTP - Hypertext Transfer Protocol.
9. ICMP - Internet Control Message Protocol.
10. IGMP - Internet Group Management Protocol
11. IP - Internet Protocol.
12. iSCSI - Internet Small Computer System Interface.
13. JBOD - Just a Bunch of Disks.
14. JPEG - Joint Photographic Experts Group.
15. MJPEG - Motion JPEG.
16. MP - Megapixel.
17. MPEG - Moving Pictures Experts Group.
18. NAS - Network Attached Storage.
19. NTP - Network Time Protocol.
20. POS - Point of Sale.
21. PPPoE - Pont to Point Protocol over Ethernet.
22. RAID - Redundant Array of Independent Disks (Drives).
23. RTP - Real-Time Transport Protocol.
24. RTCP - Real-Time Control Protocol.
25. RTSP - Real-Time Streaming Protocol.
26. SMTP - Simple Mail Transfer Protocol.
27. SNMP - Simple Network Management Protocol.
28. SSL - Secure Sockets Layer.
29. TCP - Transmission Control Protocol.
30. UDP - User Datagram Protocol.
31. UPnP - Universal Plug and Play.
32. VMS - Video Management System.
33. PoS - Point of Sales.
34. VA - Video Analytics.
35. PnP - Plug and Play.
36. ARB - Auto Recovery Backup.
37. NVR - Network Video Recorder.

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38. RAID - Redundant Array of Independent Disks.

B. Definitions:

1. JBOD: A collection of hard disks that have not been configured to act as a redundant array of independent disks (RAID) array.
2. GOV (Group of Video object planes): A set of video frames for H.264 and H.265 compression, indicating a collection of frames from the initial I-Frame (key frame) to the next I-Frame. GOV consists of 2 kinds of frames: I-Frame and P-Frame.
3. Dynamic GOV: Dynamic assignment of GOV length based on the complexity of the scene to efficiently manage bitrate of the video stream and reduce the storage required.
4. Dynamic fps: Dynamic assignment of frames per second based on the complexity of the scene to efficiently manage bitrate of the video stream and reduce the storage required.
5. ARB (Auto Recovery Backup): Automatic backup mechanism that enables cameras to store videos on to SD card during failures and stream it to the storage device after recovery.
6. Failover: A feature that automatically switches to a redundant or standby device upon failure or unexpected shutdown of an active device.

1.7 SUBMITTALS

A. Project Initiation:

1. Within fourteen (14) days of Notice to Proceed, the data network system installer shall furnish the following in a single consolidated submittal:
  - a. Permits: The Contractor shall obtain all required permits and provide copies to the Owner / Architect / Engineer.
  - b. Product Literature: Complete manufacturer's product literature for all material, hardware, and equipment to be used in the installation of the specified system. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner / Designer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicated what specific product is to be provided
  - c. Construction Schedule: A time-scaled Construction Schedule, indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
  - d. Specification Compliance: A letter shall be provided stating, by section and subsection, that the SCS installer complies with the entire specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been approved by the Owner.
  - f. Each Submittal must have a detailed parts list. Quantities will not be required as the quantity of any portion of this system shall be as required for a complete and functional system and in conjunction with the contract documents.
  - g. Certifications: The contractor shall submit all certifications for approved products and the certifications must contain dates which

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are valid from the date of proposal and not expire any sooner than 12 months after substantial completion of the project.

- 1) Physical Security Professional (PSP) Certification: This certification must be held by an on-staff, full-time employee of the system installer. The holder must be staffed out of the office that is located within 75 miles of the project.
- 2) Manufacturer Authorized Dealer Certification must be held by the system installer's office that is located within 75 miles of the project and shall be a company certification, not an individual certification.
- 3) Installer Certifications: Certification indicating that an individual has successfully completed installer training, issued by the VMS and Cameras Manufacturers specified herein, must be held by at least 25% of the, on-site, staff and be made available at the site if requested by the owner, architect, and/or project's technology consultant.

**B. Shop Drawings:**

1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
  - a. Proposed cable routing and grouping plan.
  - b. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
    - 1) Location of sleeved wall and floor pass-thru
    - 2) Size of sleeve at each location installed
    - 3) Quantity of cable passing through each sleeve
    - 4) Location of devices and head end equipment.
    - 6) Conduit routing, size, and quantity
  - c. Drawing Compliance: A letter shall be provided stating that the system installer complies with the entire project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been approved by the Owner.
  - d. All subcontractors shall provide submittals to general contractor for normal distribution to Architects, Engineers and the Owner's project managers.

**C. At Substantial Completion:** Provide drawings, to the Owner, to reflect installed cabling with correct labeling and cable routing.

**D. Close-out Procedures:**

1. Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. Close out technology documents shall be separated from all other trade's documents. The close out finals shall include:
  - a. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed,

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conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.

- b. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
- c. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed a list of recommended spare parts.
- d. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
- e. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the structure cabling system from the original approved shop drawings. Drawings shall consist of a scaled plan of each building showing the placement of each individual item of the technical cabling system equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
- f. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. A copy of the As-Built drawings reflecting the final locations of all cabling shall be given to the designated Owner's representative. The as-built drawings shall be prepared using AutoCAD 2012 or later. Provide the Owner with electronic versions of the as-builts on CD media.
- g. All drawings must reflect final graphic numbering, point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
- h. A copy of the manufacturer's warranty on the installed system.
- i. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
- j. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)
- k. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Minimum amount of training time shall be at least 4 hours.

## 1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5-year experience manufacturing similar products.
- B. System Integrator shall provide the following as part of the System Solution:

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1. Complete product and technical data specification sheets that include all material and equipment and shall be available freely online.
2. List of all equipment with part numbers, manufacturer, firmware, and assigned IP addresses.
3. Locations and details for all components to be installed under this scope of work.
4. Placement Diagram showing the proposed location of all system hardware devices.
5. System Calculation of all network bandwidth and storage requirements for System Servers to ensure proper planning of computing and networking infrastructure.

- C. Installer Qualifications: Minimum 10-year experience installing similar products. Installers shall be trained and authorized by the Manufacturer to install, integrate, test, and commission the system.

#### 1.9 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting work of this section.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Handling: Handle materials to avoid damage.

#### 1.11 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

#### 1.12 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

#### 1.13 WARRANTY

- A. The security system VMS software and labor furnished by the System Integrator including wiring, software, hardware and third-party products shall be fully warranted for parts, materials and labor for a minimum of 1 year from date of the final acceptance of the Video Surveillance System.
- B. Manufacturer shall provide a limited 3-year warranty for the product to be free of defects in material and workmanship.
- C. Software Licensing and Warranty:
1. Software licensing should be on a per device basis (e.g. 1 x license for 1 IP Camera or I/O device) with no base license for additional features or capabilities.
  2. The VMS Software should be completely free for live streaming or playback of offline media files (images, videos).

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3. Lifetime software upgrades shall be provided by the Manufacturer without cost and without the need for an annual maintenance agreement.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Existing Manufacturer:
  1. OnSSi
- B. Requests for substitutions will be considered in accordance with provisions of Division 1

### 2.2 IP SERVER

- A. IP Server shall be designed to run on a Windows platform, supporting both Desktop and Server class operating systems including Windows 7, 10(Pro), 2008 R2, 2012, 2016.
- B. It shall run as a Window's Service. This service shall run as part of the local service account. This service shall be running as long as the system is booted and has started Windows. It shall not require the user to be logged in.
- C. It shall store settings in SQL Express and shall not require a full MS-SQL license.
- D. It shall have an option for a 32-bit binary and a true 64-bit binary. In a 64-bit OS, it shall run as a native 64-bit application, not merely a 32-bit application.
- E. The service shall connect to the camera and handle streaming to the server. It shall not require each client to connect to individual cameras.
- F. This service shall allow the cameras to be placed on one network and the clients on a separate network using a different IP range.
- G. The software shall support the ONVIF standard.
- H. The software shall support Megapixel virtual cameras within a single camera license.
- I. The server shall only require two ports for streaming video as well as handling any setting changes or commands from the client software.
- J. IP Server shall record the video streams from different cameras.
  1. The service shall handle transcoding of the camera streams if the cameras are MJPEG based. The video shall be re-encoded to WMV to reduce storage needs and to reduce the impact of streams to clients on the server.
  2. For MPEG-4 based cameras, the video shall be stored in the native codec of the server.
  3. For H.264/H.265 based cameras the video shall be stored in the native codec of the server.
  4. Each camera will have the option to be able to be stored in different locations (i.e. One locally, another on a NAS, a third on a different network share).
  5. Streaming from server to client shall support H.264/H.265.
  6. The server must have Pivot 3 integration.

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- K. IP Server shall support H.264/H.265, MPEG-4, MJPEG and MXPEG based cameras.
- L. IP Server shall support motion detection at the camera and at the software levels.
- M. IP Server shall provide graphic examples of what it determines as motion to thick clients if the thick client requests it.
  - 1. The software shall display the motion detection as an outline around the area moving.
  - 2. The software shall provide a bar showing the total percentage of change. This bar shall have a slider on it to allow the user to quickly set motion detection.
- N. IP Server shall allow for multiple zones to be set within an image that support differing motion detection values within a cameras field of view.
  - 1. There shall be no limit on the total number of zones allowed, either on a per camera or per server basis.
  - 2. Zones should allow the ability to ignore motion within an area.
  - 3. The user shall have the ability to move the zones after the fact.
  - 4. Motion zones should be able to be tied into a rules engine to allow the software to use them as triggers for events.
- O. IP Server shall support the use of imported maps to show camera placement. These formats for these maps will be JPG, GIF or BMP as determined by the user.
  - 1. Hovering over a camera on a map shall cause it to be displayed in a window on the side.
  - 2. When the camera is displayed on the side, the option to review recently recorded video will be available to them.
  - 3. The user shall be able to embed layouts onto the facility map. Clicking on the layout shall change the display of the client software.
  - 4. Alarms from DIOs shall be able to be embedded as well.
  - 5. Audio sources shall also be an option.
  - 6. Other facility maps shall also be an option to embed. Clicking on a different embedded map shall bring up that map.
  - 7. Doors from certain access control systems can be imported and displayed. Hovering over the door shall display the last badge used to badge in, a live view of the camera associated with the door. The user from this pop up shall be able to see badge events and alarm events along with the associated video.
- P. IP Server shall not require the administrator to contact the manufacturer to replace a camera.
- Q. IP Server shall support reporting to a diagnostic tool.
  - 1. Number of active cameras.
  - 2. Active cameras offline.
  - 3. Version of the server.
  - 4. Amount of disk space left.
  - 5. Recording status of the server.
- R. IP Server shall support pre-motion and post motion recording.
- S. IP Server shall support customizable layouts. The layouts will allow for blank spaces within the layout.

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- T. IP Server shall support an unlimited number of users.
  - 1. Users can be drawn from either an Active Directory server, Novell eDirectory or entered manually.
  - 2. There will be five different levels of user.
  - 3. Users can be members of a group with settings set for the group. Individual user settings can override the group settings.
  - 4. Permissions can be set for live viewing, access to recorded video, control of PTZ cameras, access to audio, the ability to export video, custom layouts, facility maps and rules. Permissions can be defined on a per camera basis.
  - 5. It shall support the option of having the users limited to being signed in, to a single location.
  
- U. IP Server will include a diagnostic version with limited interface, to allow for testing of the server.
  
- V. It shall support an optional secondary server with failover capacity.
  
- W. A rules engine shall be included to allow the server to handle more complex tasks.
  - 1. Triggers will include:
    - a. Dry contacts (DIO).
    - b. Motion detection of a camera stream.
    - c. Scheduled events. Events can be scheduled on daily, weekly, or monthly basis. Individual events can be handled as well.
    - d. An Alert button for the user interaction in the VI Monitor.
    - e. Inputs sent programmatically via appropriate APIs.
    - f. Access control events from supported Access Control Vendors.
  - 2. Actions will include:
    - a. Logging the event.
    - b. Opening or closing a dry contact.
    - c. Sending an e-mail with a custom text message tied to the trigger. Multiple texts will be allowed for different triggers.
    - d. Sending an e-mail with an AVI/MP4 clip from a selected camera.
    - e. Sending an e-mail with a JPG file of a selected event from a camera.
    - f. Opening a live window for a user who is viewing.
    - g. Move a PTZ to a certain preset location.
    - h. Force recording.
    - i. Force recording with audio.
    - j. Instant Replay.
    - k. Sending video to a Network Decoder.
    - l. Switching single camera or layout views.
    - m. Message Instruction.
    - o. Moving, copying or deleting of files.
    - p. Execute a program or batch file.
    - q. Send an ASCII string to a TCP port.
  
- X. IP Server shall support time out functionality.
  - 1. A universal RTSP option shall exist for adding cameras if they are not currently supported through native APIs.
  
- Y. PTZ functionality within the camera will be supported.
  
- Z. Dewarping of Panoramic shall be supported for the following manufacturers:

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1. Avigilon
2. Axis
3. Hanwha

- AA. IP Server will only stream video to the clients that requested them.
- BB. If live video is paused, then IP Server shall stop streaming video to the clients to conserve bandwidth.
- CC. IP Server shall support integration with various access control platforms, including:
1. MonitorCast v.4
  2. AMAG
  3. Continental
  4. Infinias
  5. Isonas
  6. Lenel
  7. CCURE
  8. DSX
  9. S2
- DD. IP Server shall have support panic button functionality through rules engine.

### 2.3 VMS – (VIDEO MANAGEMENT SYSTEM)

- A. VMS shall be a thick client for viewing live and recorded video, along with handling administrative tasks.
- B. The software shall not require a client license to operate.
- C. The thick client will support an encrypted XML file for storing settings. The file can be set up to be shared between many clients, allowing the administrator to update all clients with a single file push.
1. Clients will be able to use Active Directory to authenticate users.
  2. Clients will be able to use Novell E-directory to authenticate users.
  3. VMS shall have a searchable timeline for multiple events.
  4. Motion.
  5. Access Control (integration required).
  6. Rules.
  7. LPR (License Plate Recognition).
  8. VCA (Video Content Analytic).
- D. VMS shall display the servers it's connected to along with the server's cameras in a tree view on the left-hand side.
1. The tree view will allow the user to see the status of the servers that the instance the VMS is aware of.
  2. The tree view will also include access to custom layouts, facility maps and action buttons.
  3. There will be an option to hide the tree on startup of the VMS.
  4. The user shall be able search for cameras using a searchable box on the left-hand tree.
- E. The thick client will not be limited in the number of servers it can connect to.
- F. Live view will allow views of 1, 2, 4, 8, 9, 10, 13, 16, 25 and 36 cameras. A widescreen option for 18 and 24 cameras will also be available.
1. Layouts will be selectable via icon.
  2. Layouts will not be limited to cameras from a single server.

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3. Users will be able to get layouts to cycle in the client's workspaces.
  4. Layouts shall be able to be put into groups.
- G. If motion is detected on a camera, the software shall have the option to indicate it by highlighting the edge of the live window.
  - H. Live view will allow cameras to be dragged and dropped onto the live view from the left-hand tree. Cameras can be duplicated in a view.
  - I. Users will be able to invoke a digital zoom by drawing a box.
  - J. After invoking the digital zoom, the VMS shall support the use of picture in picture within the zoomed image.
  - K. Digitally zoomed areas will be treated as a digital PTZ.
  - L. PTZ Presets shall be listed in a drop-down menu in the Dynamic Tab.
  - M. Users shall be able to move the PTZ movements simply by clicking on the image, through onscreen PTZ controls. Zoom functionality can also be controlled via the scroll wheel of the mouse.
  - N. Live view will support a full screen mode that hides the UI. User shall be able to start the VMS in this full screen mode with a setting.
  - O. Live view shall allow the user to de-warp the video from panoramic lenses and cameras.
  - P. Right clicking on a camera in live view will have the following behaviors:
    1. Right clicking on a camera within live view will allow the user to be able to review the recently recorded video for that camera.
    2. Right clicking on a camera within live view will also allow access to the properties dialog box for that camera.
    3. Right clicking on a camera will bring up the option to save a still image of the live view.
    4. Live audio will be able to be accessed by right clicking on a camera in the live view.
    5. Allowing access to recorded video.
    6. Right-clicking on the Camera tile will allow the users to send video or messages to other users in the form of a popup window.
  - Q. Recorded video Synchronized playback will allow for cameras to simply be dragged and dropped into the player.
  - R. The exporting of video in the VMS shall have Region of Interest capability within a recorded image. This will enable segregation of image for export.
  - S. The thick client will include a repair utility for corrupted video.
  - T. The VMS shall be able to display logging information such as: changes to the server, lost camera signals, who exported recorded video, when did users log-on/off and other errors. This functionality will be limited to administrative users. The log will be exportable as txt or to the Windows clipboard.
  - U. The VMS shall also provide real time status updates for server status and camera status, including the CPU usage, disk usage, bandwidth usage, licensing and number and names of users who are logged in.
  - V. The system will support an Alarm Log to make it easier to find DIO based events.
  - W. Facility maps will be available in the software for viewing.
    1. When the user hovers over a camera in the facility map it will display the camera in a window off the side of the map.
    2. While a camera is displayed it will allow access to recorded video from that camera as well as the live stream.
    3. Cameras will display where they are pointed.
    4. Embedded layouts will change the layout of the VMS if they are clicked on.
    5. Embedded Facility maps will cause the current map to change to the embedded map if clicked on.

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- 6. The user will have the option of importing and placing doors from supported access control partners on the map. This shall allow them to see badge events as well as alarm events. It shall also support the ability to lock and unlock doors from the map.
  - 7. Integrated Panic button events will be visible on the facility map.
  - X. The VMS shall support the DCZ Joystick as well as standard USB joysticks.
  - Y. The software shall support the ability to open a live window that can be moved around. This window will be able to access the view of any camera or layout the user has access to.
  - Z. The VMS support multiple screen user environments for dynamic user interface.
  - AA. The user will be able to enable or disable the following settings:
    - 1. Server name in the live view.
    - 2. Camera Name in the live view.
    - 3. Audio notification on motion.
    - 4. Forcing aspect ratio.
    - 5. Use Direct Show for display.
    - 6. Double clicking to change the server layout.
    - 7. Double clicking expands the camera.
    - 8. Allowing multiple live windows.
    - 9. Block live windows from popping up.
    - 10. Live window always on top.
    - 11. The speed in which layouts cycle.
    - 12. Hiding left tree on start up.
    - 13. Launching Facility maps on start up.
  - BB. Users with Administrator privileges will be able to configure the server and camera settings. Users will also be able to test SMTP settings and database settings.
    - 1. Users will be able to configure the framerate of the camera, including the option to have the server record continuously from 1 to 3 fps with the option to go to the cameras designated frame rate on motion detection.
    - 2. Users will be able to select various time-lapse options for the camera.
    - 3. Users will be able to select the camera stream type.
    - 4. Users will be able to select camera or server-side motion detection.
  - CC. Users will be able to access a graphic representation of what the server's motion detection settings are picking up through the timeline.
  - DD. Users will be able to configure user settings as well as layout settings from within the thick client.
  - EE. The VMS shall allow users to send video to other users, allowing for remote live pop ups of video of important events.
  - FF. The VMS shall support Layout touring. Selecting a layout will cycle through a list of cameras.
  - GG. User shall be able to allow for remote support via the VMS.
  - HH. The VMS shall allow Region of Interest searches.
- 2.4 WEB CLIENT
- A. The Web Client shall be a truly thin client with no download required other than an internet web browser or standard web browser plugins.
  - B. The Web Client shall be platform independent and run within Microsoft Edge, Internet Explorer, Firefox, Safari, and Google Chrome.
  - C. Users will not be able to change any settings within IP Server via the thin client without Admin privileged.

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- D. Users will be able to select layouts for live viewing, or individual cameras or groups of cameras.
- E. Users will be able to access recorded video.
- F. Users will be able to download recorded video from the system.
- G. Users will be able to use the motion log to find recorded video.
- H. The Web Client shall support the use of facility maps.
- I. The Web Client will support the use of custom layouts.
- J. The Web Client shall allow remote access for iPhone, Blackberry, Windows Mobile, and Android mobile phones without the installation of an app.

2.5 HEALTH MONITOR

- A. Health Monitor will listen for reports given by the service as to its status.
- B. If Health Monitor detects anything abnormal, it will give a visual display through a web front end, or by sending out an e-mail to one or more users.

2.6 VIDEO WALL

- A. The VSS shall support video wall applications by connecting and controlling multiple workstations and monitors simultaneously.

2.7 VSS MOBILE APPLICATION

- A. The VSS shall support module applications that run on the following Operating Systems:
  - 1. Google Android.
  - 2. Android 4.0: Ice Cream Sandwich thru the most current version
  - 3. Apple iOS: 5 thru the most current version
- B. The App will have access to live cameras.
- C. PTZ functionality will be available in the App.
- D. The App will have access to recorded video.
- E. Snapshots will be able to be e-mailed from the App.

2.8 SERVERS

- A. Rackmount Servers:
  - 1. Server sizes and quantities shall be provided on storage and server calculations conducted by the system installer, based on the minimum parameters stated within the contract documents.
  - 2. Server Requirements shall meet the specifications of the VSS Manufacturer. The following specifications shall be considered minimum requirements:
    - a. Record Video and Audio: 470 Mbps.
    - b. Send data from video cameras to a hard disk array of 1 to 8 HDDs within a rack mountable format and enable playback of video and audio from the hard disk array.
      - 1) Pre-configured with VSS software.
      - 2) Remote monitoring environment for video and audio over network using a remote computer.
      - 3) SQLite, a free database technology included in the installation package.
    - c. General Properties:
      - 1) Camera Search and Discovery: Search network for connected compatible cameras via Onvif Profile S.
        - a) Cameras are Searched or Discovered:

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- b) Cameras automatically registered and current camera information (fps, days of recording) displayed.
    - c) Ability to selectively register as many as cameras can be found.
  - 2) Support dual monitor out.
  - 3) Support server backup if multiple servers are in the hive for failover for redundancy.
  - 4) Recording and Playback Functions:
    - a) Support recording 128 dual streams (256 streams) from 352 x 288 (CIF) up to 4000 X 3000 (12 MP) per channel.
    - b) 470 Mbps network camera recording throughput.
    - c) Simultaneous Playback Capability: 128 video channels.
    - d) Compression Support: H.265, H.264, and MJPEG.
    - e) NVR to record and stream AAC, PCM, g726, and MPS audio.
    - f) View status of internal connected storage hardware.
    - g) Set recording schedules.
    - h) Set up triggered recording based on:
      - 1) Sensor (input) detection.
      - 2) Motion Detection.
      - 3) Video loss detection.
    - i) Available recording settings by channel for standard and event-based recording types:
      - 1) Compression type.
      - 2) Resolution.
      - 3) Images per second.
      - 4) Quality.
      - 5) Data transfer limit.
      - 6) Pre-event and post-event record duration.
      - 7) I-frame and full frame recording.
    - j) Available actions upon reaching full HDD storage capacity:
      - 1) Stop recording.
      - 2) Overwrite.
    - k) Search recorded data by time, event trigger, motion alarms, events.
  - 5) Storage: Four, 8 TB HDDs in JBOD configuration for a maximum of 32TB.
    - a) USB connection for memory/storage device for video clip backup and settings export.
  - 6) Live View:
    - a) Remote monitoring using VSS supplied viewer.
    - b) Streams: H.265, H.264, MJPEG.
    - c) Offline Media: AVI, MKV, MP4, MOV, TS, M2TS, MPEG, MPG, FLV, WMV, 3GP, JPG, PNG, GIF, BMP, and TIFF.
    - d) Configure and exercise functions for connected PTZ cameras, including functionality with compatible USB joystick.

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- e) Capture and save snapshot images.
- f) Record current video in AVI format.
- 7) Remote Access:
  - a) Multicast or Unicast: Simultaneous access is unlimited.
  - b) Mobile Device:
    - 1) Supported Platforms:
      - a) Android.
      - b) IOS.
    - 2) Supported Remote Users: Unlimited amount either live or playback.
    - 3) Dynamic DNS (DDNS) support.
- 8) VGA and High Definition (HDMI) local monitor outputs live viewing, playback, and backup functions.
- 9) ONVIF Profile S compliance.
- 10) Alarm Connections: None on server. Use of I/O software module to support I/O control.
- d. System:
  - 1) Processor: Intel Core i5-7500 3.4 GHz.
  - 2) Memory: 8 GB DDR4.
  - 3) Operating Systems: Windows 10 IoT Enterprise.
  - 4) USB Ports: 4x USB 3.0(rear), 1x USB 3.0 Type-C (rear), 2x USB 2.0(front).
  - 5) Video Output: 2x HDMI (rear), 1x DVI (rear).
  - 6) Wi-Fi: IEEE 802.11ac.
  - 7) Other Ports: 1x PS2, 2x Wi-Fi Antennas, 3.5 mm audio in/out, 1x SPDIF out.
  - 8) Keyboard and Mouse: Included.
- e. RAID Support: None.
- f. Video Compression: H.265, H.264, and MJPEG.
- g. Recording:
  - 1) Channel Capability: No limit but recommended to use VSS Calculator.
  - 2) Bit Rate: 470 Mbps.
  - 3) Resolution Range: 352 x 288 to 4000 X 3000.
- h. Events and Response Actions:
  - 1) Triggers:
    - a) Motion.
    - b) Video loss.
    - c) Event defined by camera.
  - 2) Response Actions:
    - a) Record.
    - b) E-mail.
    - c) Activate PTZ preset.
    - d) Event Trigger program.
    - e) Sound output.
- i. Playback:
  - 1) Number of simultaneous channels: Not limited.
  - 2) Bandwidth: 470 Mbps.
- j. OS Drive: OS Drive Bays: 1, 256 GB SSD internally mounted.

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- k. Storage:
  - 1) Internal:
    - a) Number of HDDs Bays: 1 to 8 Bays
    - b) Capacity: 1 to 8 TB per HDD.
  - 2) External Types: USB HDD/Flash drive for backup of video clips, firmware update, settings backup/restore, log export.
- l. Network:
  - 1) Connectivity: 1000 Base-T Ethernet, 2 x RJ-45 connectors.
  - 2) Protocols Supported:
    - a) Transmission Control Protocol (TCP), Internet Protocol (IP) v4 and v6, User Datagram Protocol (UDP).
    - b) Configuration: Dynamic Host Configuration Protocol (DHCP).
    - c) Web Services: Hypertext Transfer Protocol (HTTP), Secure HTTP (HTTPS).
    - d) Network Services: Address Resolution Protocol (ARP), Domain Name System (DNS), Internet Control Message Protocol (ICMP): Network Time Protocol (NTP), Simple Network Management Protocol (SNMP v1/2c/3 – MIB-2), Universal Plug and Play (UPnP).
    - e) Media: Real-Time Transport Protocol (RTP), Real-Time Control Protocol, Real-Time Streaming Protocol (RTSP).
    - f) Multicast: Internet Group Management Protocol (IGMP).
    - g) Notifications: Simple Mail Transfer Protocol (SMTP).
    - h) Remote Access: Point-to-Point Protocol over Ethernet (PPPoE).
  - 3) DDNS: Support DDNS services offered by the Manufacturer and other publicly available service offerings.
  - 4) Security Features:
    - a) User password protection with group restrictions.
    - b) IP address filtering, list of allowed or blocked IP addresses.
    - c) HTTPS(SSL) login authentication.
    - d) User access log.
    - e) 802.1x authentication.
    - f) Restriction of network access/web viewer access.
  - 5) Discovery: Manufacturer shall offer a discovery program to identify all devices of his manufacture on the network, as well as ONVIF Profile S conformant devices.
- m. Alarm/Sensor Interface:
  - 1) Input (0): NO or NC, selectable.
  - 2) Output (0): NO or NC, selectable.
  - 3) Use of I/O software module to support I/O control.
- n. Audio:
  - 1) Direction: Bi-directional.
  - 2) Compression: AAC (16/48KHz), G.711 u-law, G.726 selectable.
  - 3) Output: Line level (RCA).
  - 4) Output: Line level (RCA).
- o. Electrical:

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- 1) Power: 100 to 240 VAC.
- 2) Power Supply: 800 W Redundant.
- p. Mechanical and Environmental:
  - 1) Color: Black / metal.
  - 2) Front Bezel and lock.
  - 3) Form Factor 2U Rack Mount Chassis. Sliding rails included.
  - 4) Mouse and Keyboard: Included.
  - 5) Dimensions (W x H x D): 17.2 x 3.5 x 26 inch (438 x 87.0 x 660 mm)
  - 6) Weight: 30.86 lbs. (14kg).
  - 7) Temperature; Operating and Storage: 32 to 122 degrees F (0 to 50 degrees C)
  - 8) Humidity: 5 to 85 percent, RH non-condensing.

- B. All equipment shall be delivered to the site following the schedule provided. Provide full manufacturer's warranty for all server equipment.
- C. Servers shall be preprogrammed to include a floor plan graphic of all applicable sites and the exact camera locations and name of cameras. Field verification of camera names is required to complete this task.
- D. In response to proposal, contractor shall provide owner with amounts for annual service maintenance agreement that can be purchased after warranty period has expired.

## 2.9 CLIENT WORKSTATIONS

- A. Contractor to provide one (1) client workstation with the installation location to be determined at the time of install. Additional workstation will be furnished by the Owner as required.

## 2.10 CAMERAS

- A. Camera Types:
  - 1. Tamper resistant with all movable parts enclosed behind a protective cover.
  - 2. Integrated Dome In-Ceiling flush mount.
  - 3. Water resistant.
  - 4. 3-year warranty on all cameras.
- B. Color Cameras
  - 1. Acceptable Manufacturers:
    - a. Avigilon
    - b. Axis
    - c. Hanwha
    - d. Reference Video Surveillance Camera Schedule for model numbers, accessories, and additional information.
- C. Field of View Determination by the contractor as necessary for fixed camera locations shall be performed at no additional cost to provide the view desired by the owner. Contractor shall coordinate all final camera views and locations with owner for final approval.

## 2.11 ADDITIONAL HARDWARE OR EQUIPMENT REQUIRED

- A. Licensing
  - 1. Provide the owner with all licenses as required for installation

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## PART 3 EXECUTION

### 3.1 PREPARATION

- A. System Integrator: Confirm the solution proposal planning and design with the installing contractor.
- B. The network design and configuration to be verified for compatibility and performance with the input/output devices.
- C. Network Configuration: Tested and qualified by Contractor prior to remote device installation.
- D. Equipment to be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
- E. All firmware found in products to be the latest and most up to date provided by the manufacturer, or of a version as specified by the provider of the Video Management Application (VMA).
- F. All equipment requiring users to log on using a password to be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.
- G. Confirm hardware will be stored in an environment where temperature and humidity are in the range specified by the Manufacturer.

### 3.2 INSTALLATION

- A. General
  - 1. Install products per manufacturer's recommendations and approved submittals.
    - a. Comply with documentation provided by the System Integrator to ensure all steps have been taken to provide a reliable, easy-to-operate system.
  - 2. Contractor personnel must comply with all applicable state and local licensing requirements.
  - 3. Before permanent installation of the system, the Contractor will test the system in conditions simulating the final installed environment witnessed by the System Integrator. Adjust as required until proper operation is achieved.
- B. Cable Support:
  - 1. All wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
  - 2. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the J-MOD™ support hook to the treaded rod.
  - 3. Cable support shall be installed at a maximum of 5' on center.
  - 4. All cable installed shall be attached to the support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each cable support to keep wires neatly bundled throughout the entire run. Tie wraps will only be allowed to be used inside the control panels as required to manage the wires within each type of panel.
  - 5. Absolutely no cable, not installed in conduit, will be allowed to be attached directly to the building's steel or supported in any other method than that stated above.

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6. It is the responsibility of the installing contractor to coordinate with all other trades on the project to insure that the pathway of this system does not interfere with the installation of the other trades and to prevent the installed product of other trades from putting strain on the installed wiring.
7. Do not route cable through webbing of structural steel.

C. Conduit / Raceway:

1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC.
3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
5. All conduit ends shall have a protective bushing to prevent cable damage. Bushings must be installed prior to installing cable. Cutting bushing to install around installed cables will not be accepted.

D. Fire Wall Penetrations: The Contractor shall avoid penetration of fire rated walls and floors wherever possible. Contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.

E. Wall Penetrations: Where penetrations are necessary, they shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant.

F. Provide three-sided pre-finished metal hood and seal to wall where conduit penetrates exterior wall.

G. Install new roof mounted conduits on portable pipe supports – (low profile type), as manufactured by Portable Pipe Hangers or Advanced Support Products. Provide roof protection pads under each support. Coordinate location and routing with design engineer prior to rough-in or installation of system.

H. Do not install wall mounted cameras into metal fascia. Ensure they are mounted into brick, and sealed top and sides (not bottom)

### 3.3 EQUIPMENT RACK CONFIGURATION

- A. Cable Placement: Cable installation in the wiring closet must conform to the Project Drawings. All cabling shall be routed so as to avoid interference with any other service or system, operation, or maintenance location. Avoid crossing areas horizontally just above or below any riser conduit. Lay and dress cables to allow other cables to enter the conduit/riser without difficulty at a later time by maintaining a working distance from these openings.
- B. Cable shall be routed as closely as possible to the ceiling, floor or corners to ensure that adequate wall or backboard space is available for current and future equipment. All cable runs within the wiring closet shall be horizontal or vertical

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within the constraints of minimum cable bending radii. Minimum bend radius shall be observed. Cables shall not be tie-wrapped to electrical conduit or other equipment.

- C. All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels.

### 3.4 WIRING INSTALLATION

- A. General:
  1. Cabling between wiring closet and camera locations shall be made as individual home runs. No intermediate splices may be installed or utilized between the wiring closet and the camera location.
  2. All cable must be handled with care during installation so as not to change performance specifications.
- B. Placement: All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair the Owner's efficient use of their full capacity.

### 3.5 DOCUMENTATION

- A. Labels: The Contractor shall label all outlets using permanent machine engraved labels approved by the Owner. Label patch panels in the wiring closet to match those on corresponding camera locations. The font shall be at least one-eighth inch (1/8") in height, block. All labels shall correspond to as-builts and to final test reports.
- B. Contractor shall ensure complete typed labeling of all cameras with numbers that correspond to locations on video server. Labeling system shall correspond to the Owner's labeling system. Verify with Owner. Provide tags (black letters on white labels, plastic coated) on all cables and outlets.
- C. All cables shall be labeled at both ends with a machine label and all terminations shall be stenciled with a typed label for quick circuit identification. Labeling shall conform to TIA/EIA standard 606 and include interconnect cable identification numbers.
- C. A floor plan, clearly labeled with all numbered camera locations, shall be included in the as-built plans.

### 3.6 CABLE TESTING - BY MANUFACTURER'S REQUIREMENTS

- A. Notification: The Owner/Architect/Engineer shall be notified one week prior to any testing so that the testing may be witnessed.
- B. Final Acceptance: Before requesting a final acceptance, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and timetable for all copper and fiber optic cabling.
- C. Procedures: Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor's use of the

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recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation shall be evaluated in the context of each of these factors.

- D. Errors: When errors are found, the source of each error shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Retest results must be entered on the test results form. All corrections shall be made prior to final acceptance test.

### 3.7 INSPECTION

- A. Conformance to the installation practices covered above are to be verified when completed. In some cases, the Owner/Architect/Engineer may observe before acceptance.

### 3.8 WARRANTY

- A. Guarantee and warrant all equipment provided for a period of 3 years following date of substantial completion, or a period equal to the stated guaranty/warranty offered by the product manufacturer, whichever is the longest in duration.
- B. All such warranties shall include all parts (DVR's, and Power Supplies).
- C. Labor and all other costs as necessary to maintain the equipment in operating condition as intended by the product manufacturer after a period of 1 year shall be negotiated with the owner upon project completion

END OF SECTION

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**SECTION 284600  
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 078400 - Firestopping: Materials and methods for work to be performed by this installer.
- B. Section 233300 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

**1.03 REFERENCE STANDARDS**

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits 2002 (Corrigendum 2012).
- D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 72 - National Fire Alarm and Signaling Code Most Recent Edition Cited by Referring Code or Reference Standard.
- F. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Proposal Documents: Submit the following with cost/time proposal:
  - 1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
  - 2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
  - 3. Proposed maintenance contract.
- C. Drawings must be prepared using AutoCAD Release 2018.
- D. Evidence of designer qualifications.
- E. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
  - 1. Copy (if any) of list of data required by authority having jurisdiction.
  - 2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
  - 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.

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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.
- F. Evidence of installer qualifications.
- G. Evidence of instructor qualifications; training lesson plan outline.
- H. Evidence of maintenance contractor qualifications, if different from installer.
- I. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
  2. Submit documentation of satisfactory inspections and tests.
  3. Submit NFPA 72 "Inspection and Test Form," filled out.
- J. Operating and Maintenance Data: See Section 017800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
1. Complete set of specified design documents, as approved by authority having jurisdiction.
  2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
  3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
  4. List of recommended spare parts, tools, and instruments for testing.
  5. Replacement parts list with current prices, and source of supply.
  6. Detailed troubleshooting guide and large scale input/output matrix.
  7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
  8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.
- K. Project Record Documents: See Section 017800 for additional requirements; have one set available during closeout demonstration:
1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
  2. "As installed" wiring and schematic diagrams, with final terminal identifications.
  3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.
- L. Closeout Documents:
1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
  2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.

### 1.05 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

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- 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.

## 1.06 WARRANTY

- A. See Section 017800 - 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.
- 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. Same manufacturer as control units.
  - 2. Provide initiating devices and notification appliances made by the same manufacturer, where possible.

### 2.02 FIRE ALARM SYSTEM

- A. Fire Alarm System: Provide modifications and extensions to the existing 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: N/A.
  - 9. Master Fire Alarm Control Unit: Existing, located at Building "H" Transformer Room 337C.
- 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.

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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 EXISTING COMPONENTS**

- A. Existing Fire Alarm System: Remove existing components indicated and incorporate remaining components into new system, under warranty as if they were new; do not take existing portions of system out of service until new portions are fully operational, tested, and connected to existing system.
- B. Clearly label components that are "Not In Service."
- C. Remove unused existing components and materials from site and dispose of properly.

**2.04 FIRE SAFETY SYSTEMS INTERFACES**

- A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
- B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
- C. HVAC:
  1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.

**2.05 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. Master Control Unit: As specified for Basis of Design above, or equivalent.
- D. Remote Annunciators: New E3-LOC with NGA and Microphone in Building "A" Lobby 115.
- E. 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: MS-7AF.
  3. Smoke Detectors: ASD-PL3.
  4. Heat Detectors: ATD-L3.
  5. Addressable Interface Devices: AOM-2RF.
- F. Notification Appliances:
  1. Speakers: System Sensor.
  2. Strobes: System Sensor.
- G. Circuit Conductors: Copper or optical fiber; provide 200 feet extra; color code and label.

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- H. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.
  - 1. Signaling Line Circuits: Provide surge protection at each point where circuit exits or enters a building, rated to protect applicable equipment.
- I. Locks and Keys: Deliver keys to Owner.
- J. 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. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.
- B. Obtain Owner's approval of locations of devices, before installation.
- C. Install instruction cards and labels.

#### **3.02 INSPECTION AND TESTING FOR COMPLETION**

- A. Notify Owner 7 days prior to beginning completion inspections and tests.
- B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.
- E. Provide all tools, software, and supplies required to accomplish inspection and testing.
- F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.
- G. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

#### **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

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- demonstration.
- 3. Have authorized technical representative of control unit manufacturer present during demonstration.
- 4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
- 5. Repeat demonstration until successful.
- B. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
  - 1. Approved operating and maintenance data has been delivered.
  - 2. All aspects of operation have been demonstrated to Owner.
  - 3. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
  - 4. Specified pre-closeout instruction is complete.

**3.05 MAINTENANCE**

- A. See Section 017000 - 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.
  - 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**

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## SECTION 311000 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 011000 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 011000 - Summary: Sequencing and staging requirements.
- C. Section 015000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- D. Section 015713 - Temporary Erosion and Sediment Control.
- E. Section 017000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.
- F. Section 017419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- G. Section 024100 - Demolition: Removal of built elements and utilities.
- H. Section 312323 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.
- I. Section 329300 - Plants: Relocation of existing trees, shrubs, and other plants.
- J. Section 329300 - Plants: Pruning of existing trees to remain.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. Fill Material: As specified in Section 312323 - Fill and Backfill

### PART 3 EXECUTION

#### 3.01 SITE CLEARING

- A. Comply with other requirements specified in Section 017000.
- 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



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sediment control BMPs.

- 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 6 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 015000 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**

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## SECTION 312200 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 311000 - Site Clearing.
- B. Section 312316 - Excavation.
- C. Section 312316.13 - Trenching: Trenching and backfilling for utilities.
- D. Section 312323 - 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 312323.
- B. Other Fill Materials: See Section 312323.

### 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 312323 for filling procedures.
  - G. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.
  - H. 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.

### 3.06 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 0.10 foot (1-3/16 inches) from required elevation.

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- 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 312323 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**

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## SECTION 312316 EXCAVATION

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Excavating for footings, slabs-on-grade, paving, and site structures.
- B. Trenching for utilities outside the building [\_\_\_\_\_].

#### 1.02 RELATED REQUIREMENTS

- A. Project Geotechnical Report: Bore hole locations and findings of subsurface materials.
- B. Section 015713 - Temporary Erosion and Sediment Control: Slope protection and erosion control.
- C. Section 017000 - 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 311000 - Site Clearing: Vegetation and existing debris removal.
- E. Section 312200 - Grading: Soil removal from surface of site.
- F. Section 312200 - Grading: Grading.

#### 1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction Current Edition.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. Bedding and Fill to Correct Over-Excavation:
  - 1. See Project Geotechnical Report and Construction Drawings for bedding and corrective fill materials at utility trenches.

### 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.

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### **3.04 SUBGRADE PREPARATION**

- A. See Project Geotechnical Report for subgrade preparation at utility trenches and general excavation.

### **3.05 FILLING AND BACKFILLING**

- A. See Project Geotechnical Report and Construction Drawings for fill, backfill and compaction requirements at general excavation.
- B. See Project Geotechnical Report and Construction Drawings for fill, backfill and compaction requirements at utility trenches.

### **3.06 FIELD QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces by Architect before placement of foundations.

### **3.07 CLEANING**

- A. Remove excavated material that is unsuitable for re-use from site.
- B. Remove excess excavated material from site.

### **3.08 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**

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**SECTION 320190  
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
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

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- 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.
- 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.

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- 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**

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**SECTION 321123  
AGGREGATE BASE COURSES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Aggregate base course.

**1.02 RELATED REQUIREMENTS**

- A. Section 312200 - Grading: Preparation of site for base course.
- B. Section 312316.13 - Trenching: Compacted fill over utility trenches under base course.
- C. Section 312323 - Fill: Compacted fill under base course.
- D. Section 321216 - Asphalt Paving: Finish and binder asphalt courses.
- E. Section 321313 - 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 2017 (Reapproved 2021).
- B. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18 in.) Drop 2021, with Errata (2022).
- C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates 2019.
- 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>)) 2012 (Reapproved 2021).
- E. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method 2015, with Editorial Revision (2016).
- 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>)) 2012 (Reapproved 2021).
- G. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method 2015.
- H. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) 2017, with Editorial Revision (2020).
- I. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) 2017a, with Editorial Revision (2021).
- J. Standard Specifications for Public Works Construction (Greenbook); current edition.
- K. Project's Geotechnical Report.

**1.04 SUBMITTALS**

- A. See Section 013000 - 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**

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## 2.01 MATERIALS

- 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 014000 - 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 014000 - 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.

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**3.06 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**

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## **SECTION 321216 ASPHALT PAVING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Single course bituminous concrete paving.
- B. Double course bituminous concrete paving.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 312200 - Grading: Preparation of site for paving and base.
- B. Section 312323 - Fill: Compacted subgrade for paving.
- C. Section 321123 - Aggregate Base Courses: Aggregate base course.
- D. Section 321313 - Concrete Paving: Concrete substrate.
- E. Section 321313 - Concrete Paving: Concrete curbs.
- F. Section 321713 - Parking Bumpers: Concrete bumpers.
- G. Section 321723.13 - Painted Pavement Markings

#### **1.03 REFERENCE STANDARDS**

- A. AI MS-2 - Asphalt Mix Design Methods 2015.
- B. AI MS-19 - Basic Asphalt Emulsion Manual 2008.
- C. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction 2009a.
- D. Standard Specifications for Public Works Construction (Greenbook); current edition.
- E. Project's Geotechnical Report.

#### **1.04 QUALITY ASSURANCE**

- A. 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 50 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.

#### **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:
  - 1. Base Course: 1 inch.
  - 2. Surface Course: 1/2 inch.

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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 ASTM D2172 California Test Method 382 or ASTM D4125.

## **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 321123.

### **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 existing surfaces.

### **3.04 PLACING ASPHALT PAVEMENT - SINGLE COURSE**

A. Install Work in accordance with Greenbook.

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 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 1/4 inch.

### **3.07 FIELD QUALITY CONTROL**

A. See Section 014000 - Quality Requirements, for general requirements for quality control.

B. Provide field inspection and testing. Take samples and perform tests in accordance with California Test Method 308.

### **3.08 PROTECTION**

A. Immediately after placement, protect pavement from mechanical injury for 2 days or until surface temperature is less than 140 degrees F.

**END OF SECTION**



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**SECTION 321313  
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. Detectable warnings.

**1.02 RELATED REQUIREMENTS**

- A. Division 03 Section Cast-in-Place Concrete
- B. Division 05 Section Pipe and Tube Railings.
- C. Division 31 Section Earthwork
- D. Division 32 Section Architectural Site Concrete
- E. Division 32 Section Concrete Paving Joint Sealants
- F. Division 32 Section Chain Link Fences and Gates
- G. Division 32 Section StreetBond SB150

**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.
  - 14. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
    - a. Contractor's superintendent.
    - b. Ready-mix concrete manufacturer.

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- c. Concrete paving subcontractor.
- d. District's or Client's Representative
- e. Architect's Representative
- f. Inspector of Record
- g. 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. Wheel Stops: 6 - 7 inches wide in 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 trial mixtures, include trial mix proportions, test results, graphical analysis and show required average compressive strength f<sub>c</sub> results. Provide gross weight and yield per cubic yard of trial mixes.
    - b. Indicate quantity of each ingredient per cubic yard of concrete and percentages.
    - c. Indicate type and quantity of admixtures proposed or required.
    - d. Indicate water to cement ratio by weight.
    - e. Measured slump.
    - f. Measured air content.
    - g. Provide shrinkage test results.
  - 5. Multiple mix designs or multiple manufacturers shall not be permitted for the same application.
- D. Mix designs should contain no fly ash.
- E. 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.
- F. 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.

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- 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 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.
- H. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.
- I. Qualification Data: For qualified ready-mix concrete manufacturer (batch plant) and installer of detectable warnings.
- J. 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.
- K. Material Certificates: For the following, submit manufacturer data, test results, and technical information for aggregate, sand and cement, submit 1 pint 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. Admixtures.
  - 5. Curing compounds.
  - 6. Applied finish materials.
  - 7. Bonding agent and epoxy adhesives.
  - 8. Joint fillers.
  - 9. Sealer
  - 10. Sealant.
  - 11. Pigments.
- L. 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.
- M. Detectable Warning Device Warranty: Submit copies of manufacture's five year warranty for each of these products and manufacturer custom and standard color palette.
- N. 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.
- 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.
  - 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.

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- E. Industry Standards: Comply with the following unless modified by requirements in the Contract Documents.(Plans and specifications)
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.
- 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. Retarder Finishes: Mock ups shall clearly demonstrate an even finish. No blotchy or light areas.
    - d. Abrasive-Blast Finishes: Mockups shall clearly demonstrate 3 levels of depth of cut for abrasive-blast finishes for Architect's review.

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- e. Stairs: Construct minimum 2 risers and treads X 4' long with nosing grooves and stained color within grooves for each color and finish specified.
- f. Mow Strip: minimum 6' long for each specified width and color.
- g. Truncated Domes: minimum 3'X6' long set in concrete with concrete base and grout.
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.
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.

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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 ½-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.
    - 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. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- B. Low-Alloy-Steel Reinforcing Bars (for Welding): ASTM A 706/A 706M, Grade 60, deformed, unless otherwise indicated.
- C. 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.
- D. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- E. 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.
- F. 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:

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1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

G. 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.
    - a. 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. Negligible: Class 2N.
    4. Service Class, based on CBC Figure 1904.2., "Weathering Probability Map":
      - a. 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.
  - E. 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 - Hydrotint(Liquid)
    2. Color: As indicated on plans.

### 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; Aquafil.

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- 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.
- 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 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.

## 2.06 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.

## 2.07 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. 1/4" thickness.
- 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".
- C. 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.
- D. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of reveal specified.
  - 1. Provide W. R. Grace "Top-Cast".



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## 2.08 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-24, 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. Color: Yellow
  4. 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: Dark Gray (Federal Color No. 36118), Onyx Black (Federal Color No. 17038), or , Yellow (Federal Yellow No. 33538)
- 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. 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 A-40 Yellow (Federal Yellow No. 33538)

## 2.09 PAVEMENT MARKINGS

- A. Color: [White] [Yellow] [Green] [Blue] [As indicated].
- 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.

## 2.10 WHEEL STOPS

- A. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 5-1/2 to 6 inches high by 7 inches wide by 48 inches long at singles stalls and 72 inches long at shared stalls. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.
1. Dowels: Galvanized steel or rebar, 1/2 inch in diameter, 18-inch minimum length.

## 2.11 CONCRETE MIXTURES

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- 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. 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.
- C. 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.
- D. Limit "drying shrinkage" after 28 days of curing hardened concrete to 0.045 percent of the original concrete volume.
- E. Limit water-soluble, chloride-ion content in hardened concrete to [0.15] [0.30] percent by weight of cement.
- F. 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 and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  2. 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.

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3. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- G. 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.

## 2.12 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. 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.
- C. 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.
  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.

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- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. 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.
- 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.

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- 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. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
- L. 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.
- M. 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.
- N. 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 RETARDER FINISHING(FINE AGGREGATE)

- A. Protect all surrounds from overspray of liquid materials, including, but not limited to, adjacent horizontal surfaces, windows, roofs, walkways, drives, and landscaping.
  - 1. Apply surface protectant and /or plastic sheeting, sufficiently taped in place.
- B. Ensure to screed surface of concrete evenly to designated slope shown on approved civil grading plans.

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- C. Prepare concrete for retarder finish as recommended by retarder manufacturer.
  1. Consider using rolling tamper, jitterbug or rolling jitterbug to create a denser surface paste with no obstruction due to the appearance of coarse aggregate, allowing for a uniform sand texture.
  2. Screed or strike off the surface in two (2) directions using a wooden or metal straight edge to achieve the proper elevation in a sawing motion back and forth.
  3. Allow the bleed water to evaporate from the surface.
  4. Float concrete using a wooden hand/bull float.
  5. Float to a uniform appearance.
  6. Hand trowel or Fresno steel frowel to create tight dense smooth surface.(This could require 2 - 3 passes depending on mix design and/or desired finish to be achieved)
  7. Do not burnish the surface or allow the exposed sand surface to prematurely dry prior to the application of the surface retarder.
- D. Mix surface retarder thoroughly prior to each use.
- E. Apply surface retarder per manufacturers recommendations.
- F. Remove retarder per manufactures recommendations.

### 3.09 EXPOSED AGGREGATE FINISHING(COURSE AGGREGATE)

- A. Protect all surroundings from overspray of liquid materials, including, but not limited to, adjacent horizontal surfaces, windows, roofs, walkways, drives, and landscaping.
  1. Apply surface protectant and /or plastic sheeting, sufficiently taped in place.
- B. Ensure to screed surface of concrete evenly to designated slope shown on approved civil grading plans.
- C. Prepare concrete for retarder finish as recommended by retarder manufacturer.
  1. Do not use tools that may force the aggregate away from the surface creating a non-uniform surface after exposure.
  2. Screed or strike off the surface in two (2) directions using a wooden or metal straight edge to achieve the proper elevation in a sawing motion back and forth.
  3. Allow the bleed water to evaporate from the surface.
  4. Float concrete using a wooden hand/bull float.
  5. Do not overwork the surface, as this tends to drive the aggregate down away from the surface to be exposed.
  6. Float to a uniform appearance.
- D. Mix surface retarder thoroughly prior to each use.
- E. Apply surface retarder per manufacturers recommendations.
- F. Remove surface retarder per manufacturers recommendations.

### 3.10 ABRASIVE BLAST FINISHING

- A. General: Perform abrasive blasting after compressive strength of concrete exceeds 2000 psi, and is at least 28 days old Coordinate with formwork removal to ensure that surfaces to be abrasive blasted are treated at same age for uniform results.
  1. Surface Continuity: Perform abrasive-blast 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 depths of blast to match design reference sample or mockup.
  2. Abrasive Blasting: Abrasive blast corners and edges of patterns carefully, using backup boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure, and blasting techniques required to match design reference sample or mockup.
  3. Depth of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surfaces to match design reference sample or mockup, as follows and as required by Architect:

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- a. Retain degree of abrasive-blast cut in "Brush," "Light," "Medium," or "Heavy" subparagraphs below to suit Project.
  - b. Brush: Remove cement matrix to dull surface sheen and expose face of fine aggregate; with no significant reveal.
  - c. Light to Medium: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color; with maximum reveal of 1/16 inch.
  - d. Medium: Generally expose coarse aggregate; with slight reveal, a maximum of 1/8 inch.
  - e. Heavy: Expose and reveal coarse aggregate to a maximum projection of one-third its diameter; with reveal range of 1/4 to 5/16 inch.
  - f. Portland cement concrete paving shall have a medium sandblast finish equal to medium broom finish on all surfaces sloped less than 6% and slip resistant (heavy sandblast finish equal to heavy broom finish) on all surfaces sloped greater than 6%.
  - g. Portland cement concrete paving shall be stable, firm and slip resistant and shall comply with **CBC Sections 11B-302 and 11B-403**.
4. Abrasive Blasting: Abrasive blast corners and edges of patterns carefully, using backup boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure, and blasting techniques required to match design reference sample or mockup.
  5. Insert specific abrasive materials or processes if required for Project.

### 3.11 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.
- D. Stenciling:
  1. Stencils shall be derived from approved shop drawings.
  2. Cut stencils to slab width and lay on wet concrete. Overlap "mortar joint" on trailing edge of each section of stencil onto leading "mortar joint" of previous section.
  3. Trim stencils to fit slab and adjacent patterns.
  4. Apply penetrating stain to paving surfaces according to manufacturer's written instructions and as follows:
    - a. Apply first coat to stain to dry, clean surfaces by airless sprayer or by high volume, low pressure sprayer.
    - b. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color constant with approval mockup.
    - c. Rinse until water is clear. Control, collect, and legally dispose of runoff.

### 3.12 DETECTABLE WARNINGS

- 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 Federal Standard 595C**, 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-

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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. 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.
- J. Cast-in-Place Detectable Warning Pavers: Integrate into installation of unit pavers. Comply with manufacturer's written instructions.
- K. 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.

### 3.13 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.
    - 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.

### 3.14 PAVING TOLERANCES



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- 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, unlevelled 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: 1.8 percent, plus 0.2 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: 1.8 percent, plus 0.2 percent, minus 1.0 percent or as required to shed water.

### 3.15 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.
  - 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:

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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 11B503.5**.

### 3.16 WHEEL STOPS

- A. Securely attach wheel stops to paving with not less than two #4 galvanized steel dowels or rebar, minimum 18 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.

### 3.17 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

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- 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.
- 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.

### **3.18 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.

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### **3.19 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**

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**SECTION 321373  
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.
- B. Division 32 Section Architectural Site Concrete

**1.03 SUBMITTALS**

- A. Product Data: For each joint-sealant product indicated.
- B. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
- C. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- D. 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.
- E. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

**PART 2 - PRODUCTS**

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## 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. Pecora Corporation; Urexpan NR-200.
    - b. Sika Corporation, Inc.; Sikaflex - 2c SL.
  - 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. Pecora Corporation; Dynatred.
    - b. Sika Corporation, Inc.; Sikaflex - 2c NS
  - 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

- 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-

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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

- 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**

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**SECTION 321713  
PARKING BUMPERS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Precast concrete parking bumpers and anchorage.

**1.02 REFERENCE STANDARDS**

- A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2022.
- B. ASTM C33/C33M - Standard Specification for Concrete Aggregates 2018.
- C. ASTM C150/C150M - Standard Specification for Portland Cement 2022.

**1.03 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide unit configuration, dimensions.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Parking Bumpers: Precast concrete, conforming to the following:
  - 1. Nominal Size: 5.5 inches high, 7 inches wide, 4 feet long.
  - 2. Profile: Manufacturer's standard.
- B. Dowels: As indicated on drawings.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Install units without damage to shape or finish. Replace or repair damaged units.
- B. Install units in alignment with adjacent work.

**END OF SECTION**



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**SECTION 321723.13  
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. "No Parking" curb painting.

**1.02 RELATED REQUIREMENTS**

- A. Section 321216 - Asphalt Paving.
- B. Section 321313 - Concrete Paving.
- C. Section 321726 - Tactile Warning Surfacing: Plastic tactile and detectable warning tiles for pedestrian walking surfaces.

**1.03 REFERENCE STANDARDS**

- A. FS TT-P-1952 - Paint, Traffic and Airfield Marking, Waterborne 2015f (Validated 2020).
- B. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association Current Edition.
- C. 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 013000 - 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. Handicapped Symbols: Blue.
- B. Paint For Obliterating Existing Markings: FS TT-P-1952; black for bituminous pavements, gray for portland cement pavements.
- C. 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**

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- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.02 PREPARATION

- A. 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 35 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.
  1. Mark the "International Symbol of Accessibility" (ISA) at indicated parking spaces.
  2. Hand application by pneumatic spray is acceptable.

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- 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**

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**SECTION 321740  
STREETBOND SB150 (FLAT SURFACE)**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. StreetBond® Advanced Coatings for Asphalt are specifically formulated for application to asphalt pavement and have been confirmed by a certified testing facility to possess a balance of performance properties for a durable and color-fast finish.
- B. A variety of StreetBond® coating colors are available. Please refer to [gaf.com](http://gaf.com) to view these. Custom colors are available upon request.
- C. Certain colors of the StreetBond® coatings have been independently verified to have an SRI greater than 29 and therefore can help projects qualify for points in the LEED® program under Heat Island Effect: Non-Roof. Please refer to [gaf.com](http://gaf.com) for further information.
- D. Qualifications. Only Accredited StreetBond® Applicators may bid for and perform the imprinted portion of this work. Please refer to Section 1.03 DEFINITIONS.
- E. StreetBond® products are manufactured in ISO 9001:2008 / ISO 14001:2004 facilities to ensure quality products produced in legally-responsible and environmentally-
- F. conscious manner
- G. StreetBond® coatings are only available from GAF.

**1.02 REFERENCES**

- A. A. ASTM D4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Tester.
- B. B. ASTM D4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- C. C. ASTM D2697 Standard Test Method for Volume of Nonvolatile Matter in Clear or Pigmented Coatings.
- D. D. ASTM D522-93A Standard Test Method for Mandrel Bend Test of Attached Organic Coatings.
- E. E. ASTM D1653 Standard Test Method for water vapor transmission through organic film coatings.
- F. F. ASTM G154 QUV Accelerated Weathering Environment. Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.
- G. G. ASTM D2369 Weight Solids Standard test method for Volatile Content of Coatings.
- H. H. ASTM D1475 Standard Test Method for Density of Paint, Varnish, Lacquer, Other related products
- I. I. ASTM D2240 (2000) Standard Test Method for Rubber property - Durometer hardness.
- J. J. ASTM D5895 Standard Test Method of drying or curing during film formation of organic coatings using mechanical recorders.
- K. K. ASTM D570 Standard Test Method for water absorption of plastics.

**1.03 DEFINITIONS**

- A. "Accredited StreetBond® Applicator" has valid Certification for both Textured (stamped) and Non - Textured (flatwork) as offered by GAF and are reviewed on an annual basis. All Accredited StreetBond® Applicators have been qualified by GAF to perform the Work and offer a product Warranty.

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- B. "Approved Applicator" has valid Certification for non - textured (flatwork) application ONLY as offered GAF and are reviewed on an annual basis. Product Warranties may be available to Approved Applicators but require approval and supervision by a GAF Technical Sales Representative.
- C. "Applicator" means the installer of the StreetBond® coatings.
- D. "Owner" means the Owner and refers to the representative person who has decision making authority for the Work.
- E. "TSR" is a GAF Technical Sales Representative who manages the StreetBond® product in a given territory.
- F. "Stamped asphalt pavement" is asphalt pavement that has been subjected to imprinting or texturing in a specific pattern.
- G. "Non - Stamped asphalt pavement" is asphalt pavement that is unstamped and is sometimes referred to as "flatwork".
- H. The "Work" is the asphalt pavement texturing work contemplated in this bid submission and specification.
- I. "Scuffing" is a "tear" of the asphalt pavement caused by an external force - for example turning the steering wheel of a stationary vehicle. Scuffing is generally the result of poorly designed or improperly installed asphalt and would most - commonly be seen on weaker residential asphalt.
- J. "Layer" is a signal thin pass of coating, applied with a texture spray gun, which is allowed to dry before the next layer is applied.
- K. "Warranty" is a guarantee to the property owner that StreetBond® SB150, when properly applied will not peel, delaminate or show abnormal wear over specific period of time depending on the traffic volumes and number of layers applied. Please contact your local TSR for more details.

#### 1.04 1.4 SUBMITTALS

- A. A copy of the Accreditation Certificate, available from the Applicator, is required with submittal. Independent product test results available upon request.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS - STREETBOND® COATINGS

- A. StreetBond® coatings have been scientifically formulated to provide the optimal balance of performance properties for a durable, long - lasting color and textured finish to asphalt pavement surfaces. Some of these key properties include wear and crack resistance, color retention, adhesion, minimal water absorption and increased friction properties. StreetBond® coatings are environmentally safe and meet EPA requirements for Volatile Organic Compounds (VOC).
- B. StreetBond® SB150 is a two part premium epoxy - modified, acrylic, waterborne coating specifically designed for application on asphalt pavements. It has a balance of properties to ensure good adhesion and movement on flexible pavement, while providing good durability. StreetBond® SB150 is durable in both dry and wet environments.
- C. StreetBond® Colorant is a highly concentrated, high quality, UV stable pigment blend designed to add color to StreetBond® SB150 coatings. One unit of Colorant shall be used with one pail of StreetBond® coating material.
  - 1. Custom Colors
    - a. Match RAL colors noted on plans/details.

#### 2.02 PROPERTIES OF STREETBOND® COATINGS

- A. The following tables outline the test results for physical and performance properties of the StreetBond® coatings as determined by an independent testing laboratory.
- B. TABLE 1: Typical Physical Properties of StreetBond® Coatings

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1. Characteristic    Test Specification    SB150
2. Solids by Volume ASTM D2697 59.14%
3. Solids by Weight ASTM D2369 71.60%
4. Density    ASTM D1475    13.27 lbs./gal ( 1.59kg/l)

C. TABLE 2: Typical Performance Properties of StreetBond® Coatings

1. Characteristic
2. Dry time (To re-coat)
  - a. Test Specification - ASTM D5895 23 C; 37% RH
  - b. SB150 - 35 min.
3. Taber Wear Abrasion Dry H-10 wheel
  - a. Test Specification - ASTM D4060 1 day cure
  - b. SB150 - 0.33g/1000 cycles
4. Taber Wear Abrasion Wet H-10 wheel
  - a. Test Specification - ASTM D4060 7 days cure
  - b. SB150 - 0.15g/1000 cycles
5. QUV Accelerate Weathering Environment
  - a. Test Specification - ASTM G - 151 deltaE 1,500hrs.
  - b. SB150 - 0.53 (Brick)
6. Hydrophobicity Water Absorption
  - a. Test Specification - ASTM D570
  - b. SB150 - 7.89%
7. Shore A Hardness
  - a. Test Specification - ASTM D2240
  - b. SB150 - 80.8
8. Mandrel Bend
  - a. Test Specification - ASTM D522 - 93A
  - b. SB150 - 1/8" @ 23 C
9. Permeanc
  - a. Test Specification - ASTM D1653
  - b. SB150 - 5.6 perm
10. VOC
  - a. Test Specification - per MSDS
  - b. 19 g/l
11. Adhesion
  - a. Test Specification - ASTMD4541
  - b. SB150 - >300psi (692psi)
12. Friction Wet
  - a. Test Specification - ASTM E303 British Pendulum Tester
  - b. SB150 - Wet=77.3 Dry=81.3

D. Certificates of Analysis are available upon request for each of these properties.

**2.03 EQUIPMENT FOR STREETBOND® APPLICATION**

- A. The equipment described has been designed specifically for optimal application of StreetBond® coatings. Other equipment may or may not be suitable and could compromise the performance of the StreetBond® coatings and/or reduce crew productivity.
1. The SB Flex Sprayer is a proprietary coating sprayer supplied by Intech Equipment and is capable of applying the StreetBond® coatings to the asphalt pavement surface in a thin, controlled film which will optimize the drying and curing time of the coating. A Graco RTX and RapidSprayerII sprayer may also be used.
  2. The StreetBond® Coatings Mixer is a motorized mixing device designed to ensure efficient and thorough blending of the StreetBond® components.
  3. Backpack or Hand - Held sprayer to apply the diluted StreetBond® Adhesion Promoter Concentrate.

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4. The RapidFinisher II is an electric powered broom produced by HUB Surfaces Systems which can be used in the application of StreetBond® coatings to improve productivity. It is especially useful on larger projects.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL**

- A. StreetBond® coating shall be supplied and applied on non - textured asphalt surface by an Accredited StreetBond® Applicator in accordance with the plans and specifications or as directed by the Owner. Do not begin installation without confirmation of an Accreditation Certificate. Specifications for the execution of the StreetPrint® system can be found at [gaf.com](http://gaf.com).

#### **3.02 PRE-CONDITIONS**

- A. The condition of the asphalt substrate will impact the performance of the StreetBond® coatings. A highly stable asphalt pavement free of defects is recommended.
  1. Prerequisites for New Asphalt Pavement
  2. A durable and stable asphalt pavement mix design installed according to best practices over a properly prepared and stable substrate is a pre - requisite for all long - lasting asphalt pavement surfaces. The application of StreetBond® does not change this requirement.
  3. Pavement Marking Removal: recommended guidelines
  4. Pavement markings may be removed by sandblasting, water - blasting, grinding, or other approved mechanical methods. The removal methods should, to the fullest extent possible, cause no significant damage to the pavement surface.
  5. The Owner shall determine if the removal of the markings is satisfactory for the application of StreetBond® coatings. Work shall not proceed until this approval is granted.
  6. Surface Preparation
  7. The asphalt pavement surface shall be dry and free from all foreign matter, including but not limited to dirt, dust, de-icing materials, and chemical residue.

#### **3.03 APPLICATION OF STREETBOND® COATINGS**

- A. Coating Application Guidelines
- B. The Applicator shall use the SB Flex Spray System or suitable texture coatings sprayers to apply the StreetBond® coatings.
- C. The pavement surface shall be completely dry and thoroughly cleaned prior to application of the coatings.
- D. The coating application shall proceed as soon as practical upon completion of the imprinting of the asphalt pavement where applicable.
- E. For polished asphalt, StreetBond® Adhesion Promoter should be applied directly to the asphalt and allowed to dry completely prior to the first layers of coating.
- F. For concrete surfaces, StreetBond® WB Concrete Primer or StreetBond® QS Concrete Primer should be applied and allowed to cure prior to the first layers of coating. Please consult Technical Data sheets for more details on applications.
  1. Both new and existing concrete should be acid etched prior to the primer application.
- G. The first layer of coating shall be spray applied then broomed to work the coating material into the pavement surface. Subsequent applications shall be sprayed then broomed or rolled. Each application of coating material shall be allowed to dry to the touch before applying the next layer.
- H. The Applicator shall apply the StreetBond® coatings only when the air temperature is 50°F / (10°C) and rising and will not drop below 50°F / (10°C) within 24 hours. No precipitation should be expected within 24 hours.

#### **3.04 COATING COVERAGE & THICKNESS**

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- A. Coating coverage and thickness is as outlined in TABLE 4 below. Actual coverage may be affected by the texture of the asphalt pavement substrate and the imprint pattern selected. There will be less coverage with the first layer and higher coverage with subsequent layers.

B. TABLE 4: Coating Coverage & Thickness

Use	Min # of Layers	App. Rate/Layer	Total App./rate for system	Dry Film Thickness (DFT) mils
No vehicular traffic(pedestrian)	3	1 unit/600 sf	3 units/600 sf	18
Low vehicular traffic(<5 cars/day residential drives/medians/plazas)	3	1 unit/600 sf	3 units/600 sf	19
Medium vehicular traffic (<2000 cars/day)	4	1 unit/600 sf	4 units/600 sf	26
Heavy vehicular traffic (2000-3000 cars/day)	4	1 unit/600 sf	4 units/600 sf	26
Vehicular Traffic - Turn Lanes (<3000 cars/day)	6	1unit/600 sf	6units/600 sf	38

- C. Additional layers of StreetBond® SB150 coatings may be used to provide additional build thickness in high wear areas such as vehicle wheel paths and turning areas.
- D. \*1 unit is a nominal 5 gallon pail comprising Part A, Part B and Colorant (approximately 4.12 gallons). 1 unit when sprayed as a single layer covers approximately 600sqft (55.7 sqm), with an approximate thickness of 6.3mil (0.16mm) dry.
- E. No warranty is provided for traffic levels above 3000 cars per day per lane.

**3.05 OPENING TO TRAFFIC**

- A. Minimally, StreetBond® SB150 coating must be 100% dry and sufficient curing time must be allowed before traffic is permitted on the surface.
- B. If StreetBond® coatings are applied when moisture cannot evaporate, then the coating will not dry. The drying and curing of StreetBond® coatings have a direct impact on performance.

**3.06 MEASUREMENT**

- A. The measured area is the actual area of asphalt pavement where StreetBond® has been applied, measured in place. No deduction will be made for the area(s) occupied by manholes, inlets, drainage structures, bollards or by any public utility appurtenances within the area.

**END OF SECTION**

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**SECTION 323113  
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 033000 - Cast-in-Place Concrete: Concrete anchorage for posts.
- B. Section 337900 - Site Grounding.

**1.03 REFERENCE STANDARDS**

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric 2011a (Reapproved 2017).
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- E. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete 2022a.
- F. ASTM F567 - Standard Practice for Installation of Chain-Link Fence 2014a (Reapproved 2019).
- G. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework 2018.
- H. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures 2018.
- I. CLFMI CLF-PM0610 - Product Manual 2017.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on fabric, posts, rails, 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. Field Inspection Records: Provide installation inspection records that include post settings, framework, fabric, fittings and accessories, gates, and workmanship.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Fence Installer: Company with demonstrated successful experience installing similar projects and products, with not less than five years of documented experience.

**1.06 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.

**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. Wire Fabric:
- D. ASTM A392 zinc coated steel chain link fabric.
- E. Ready-mixed, complying with ASTM C94/C94M; normal Portland cement; 2,500 psi strength at 28 days, 3 inch slump; [ ] inch nominal size aggregate.

## 2.02 COMPONENTS

- A. Line Posts: 3.5 inch diameter.
- B. Corner and Terminal Posts: 4.0 inch diameter.
- C. Gate Posts: 4-1/2 inch diameter.
- D. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.
- E. Bottom Rail: 1.66 inch diameter, plain end, sleeve coupled.
- 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 Band: 3/8 inch thick steel.
- H. Tension Strap: 3/8 inch thick steel.
- I. Tie Wire: Aluminum alloy steel wire.

## 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.

## 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.

## 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.
- L. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.

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- M. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
- N. Do not attach the hinged side of gate to building wall; provide gate posts.
- O. Install hardware and gate with fabric [ ] to match fence.
- P. 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.

**3.03 CLEANING**

- A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- B. Clean fence with mild household detergent and clean water rinse well.
- C. Remove mortar from exposed posts and other fencing material using a 10 percent solution of muriatic acid followed immediately by several rinses with clean water.

**END OF SECTION**

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**SECTION 323125  
TUBE STEEL FENCE & GATES(AMERISTAR- MONTAGE II®)**

**PART 1 - GENERAL**

**1.01 WORK INCLUDED**

- A. The contractor shall provide all labor, materials and appurtenances necessary for installation of the welded ornamental steel fence system defined herein at (specify project site).

**1.02 RELATED WORK**

- A. Section 310000 - Earthwork
- B. Section 033000 - Concrete

**1.03 SYSTEM DESCRIPTION**

- A. The manufacturer shall supply a total fence system of Montage II® Welded and Rackable (ATF - All Terrain Flexibility) Ornamental Steel (specify Invincible™, Classic™, Majestic™, or Genesis™) design. The system shall include all components (i.e., panels, posts, gates and hardware) required.

**1.04 1.04 QUALITY ASSURANCE**

- A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

**1.05 1.05 REFERENCES**

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
- C. ASTM D523 - Test Method for Specular Gloss.
- D. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
- E. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
- F. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- G. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- H. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- I. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
- J. ASTM F2408 - Ornamental Fences Employing Galvanized Steel Tubular Pickets.

**1.06 SUBMITTAL**

- A. The manufacturer's literature shall be submitted prior to installation.
- B. Shop Drawings:
  - 1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
  - 2. Architect to approved prior to ordering fence and gate materials.

**1.07 PRODUCT HANDLING AND STORAGE**

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

**1.08 PRODUCT WARRANTY**

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- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.
- B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase.

**PART 2 - MATERIALS**

**2.01 MANUFACTURER**

- A. The fence system shall conform to Montage II® Welded and Rackable (ATF - All Terrain Flexibility) Ornamental Steel, (specify Invincible™, Classic™, Majestic™, or Genesis™) design, (specify extended picket or flush) bottom rail treatment, (specify 2-Rail, 3-Rail or 4-Rail) style manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma.

**2.02 MATERIAL**

- A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft2 (276 g/m2), Coating Designation G-90.
- B. Material for pickets shall be 1" square x 14 Ga. tubing. The rails shall be steel channel, 1.75" x 1.75" x .105". Picket holes in the rail shall be spaced 4.715" o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

**2.03 FABRICATION**

- A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.
- B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar' s proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).
- C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash (with zinc phosphate), followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be Black. The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).
- D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.
- E. Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 11ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6' .

**2.04 GATE HARDWARE**

- A. Refer to details for specific gate hardware models and finishes.

**PART 3 - EXECUTION**

**3.01 EXAMINATION**

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

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- B. If substrate preparation is the responsibility of another installer, notify Contractor of unsatisfactory preparation before proceeding.

### **3.02 PREPARATION**

- A. All new installation shall be laid out by the contractor in accordance with the approved plans, details and shop drawings.
- B. Clean surfaces thoroughly prior to installation.

### **3.03 FENCE INSTALLATION**

- A. Fence post shall be spaced according to approved plans, details and shop drawings, plus or minus ½". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36" (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

### **3.04 FENCE INSTALLATION MAINTENANCE**

- A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.

### **3.05 GATE INSTALLATION**

- A. Gate posts shall be spaced according to the approved plans, details and shop drawings. Gate hardware shall be provided by the Contractor and shall be installed per manufacturer' s recommendations.
- B. Post footings shall follow approved plans, details and shop drawings.
- C. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.

### **3.06 ERECTION TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From Indicated Position: 1 inch.
- C. Minimum Distance from Property Line: 6 inches.

### **3.07 CLEANING**

- A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.
- B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- C. Clean fence with mild household detergent and clean water rinse well.

### **3.08 PROTECTION**

- A. Protect installed products until completion of project.

B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

**3.09 TABLE 1 - MINIMUM SIZES FOR MONTAGE II POSTS**

Fence Posts		Panel Height	
2-1/2" x 12 Ga.		Up to & Including 6' Height	
3" x 12 Ga.		Over 6' Up to & Including 8' Height	
Gate Leaf	Gate Height		
	Up to and including 4'	Over 4' Up to & Including 6'	Over 6' Up to & Including 8'
Up to 4'	2-1/2" x 12 Ga.	3" x12 Ga.	3" x 12 Ga.
4'-1" to 6'	3"x 12 Ga.	4" x11 Ga.	4" x11 Ga.
6'-1" to 8'	3"x 12 Ga.	4" x11 Ga.	6" x 3/16"
8'-1" to 10'	3"x 12 Ga.	6"x 3/16"	6" x 3/16"
10'-1" to 12'	4"x 11 Ga.	6"x 3/16"	6" x 3/16"
12'-1" to 14'	4"x 11 Ga.	6"x 3/16"	6" x 3/16"
14'-1" to 16'	6"x 3/16"	6"x 3/16"	6" x 3/16"

**3.10 TABLE 2 - COATING PERFORMANCE REQUIREMENTS**

Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359- Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test)
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss frm scribe or meidium #8 blisters)
Impact Resistance	D2794	Impact Resistance over60 inch lb. (Forward impact using 0.625" ball)
Weathering Resistance	D822 D2244 D523 (60" Method)	Weathering resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units)

**3.11 TABLE 3 - MONTAGE II - POST SPACING BY BRACKET TYPE**

Span	For INVINCIPLE 8" Nominal(91-1/2" Rail)				For CLASSIC, GENESIS, & MAGESTIC 8" Nominal(92-5/8"					
	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Flat Mount (BB301)*		Industrial Line 2-1/2"(BB319) 3"(BB320)		Industrial Universal 2.5" (BB302) 3"(BB303)		Industrial Flat Mount (BB301)		Industrial Swivel (BB304)*	
Post Settings (+/- 1/2"	94-1/2"	95"	94-1/2"	95"	96"	96-1/2"	96"	96-1/2"	*96"	*96-1/2"



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O.C.)										
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- A. \*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel. When using the BB301 flat mount bracket for Invincible style, rail may need to be drilled to accommodate rail to bracket attachment.

**END OF SECTION**

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**SECTION 323136  
SECURITY GATES AND BARRIERS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Security gates and barriers.

**1.02 RELATED REQUIREMENTS**

- A. Section 260533.13 - Conduit for Electrical Systems: Empty conduit between system components.
- B. Section 260583 - Wiring Connections: Electrical power connections to the hydraulic power unit and controls.
- C. Section 312316 - Excavation: Excavating for footings, and utility trenching.
- D. Section 321216 - Asphalt Paving: Installation of adjacent paved surfaces.
- E. Section 321313 - Concrete Paving: Installation of adjacent paved surfaces.

**1.03 REFERENCE STANDARDS**

- A. ASTM F2200 - Standard Specification for Automated Vehicular Gate Construction 2020.
- B. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate installation of units with size, location and installation of service utilities.
- B. Preinstallation Meeting: Conduct a preinstallation meeting at least one week prior to the start of work of this section; require attendance by affected installers.
- C. Sequencing: Ensure that utility connections are completed in an orderly and expeditious manner.

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Provide detailed drawings showing:
  - 1. Layout and overall dimensions of each major element of the barrier equipment, including the power unit and operator control panels, if applicable.
  - 2. Electrical schematic including associated wiring, showing electrically connected components, including interface points for connection to equipment; indicate minimum conduit size and number of wires required to run between each component of the barrier equipment.
  - 3. Schematic drawings of the entire barrier system, with manufacturer supplied equipment connected and integrated.
- C. Manufacturer's Qualification Statement.
- D. Installer's Qualification Statement.
- E. Operation and Maintenance Data.
- F. Specimen Warranty.
- G. Project Record Documents: After completion of field tests, provide updated drawings, showing exactly where equipment and controls are installed.
- H. Maintenance Materials: Furnish the following for Owner's use in project maintenance.
  - 1. See Section 016000 - Product Requirements, for additional provisions.

**1.06 QUALITY ASSURANCE**

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- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
- B. Installer's Qualifications: Company specializing in performing the work of this section with minimum five years of documented experience.

**1.07 DELIVERY, STORAGE AND HANDLING**

- A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

**1.08 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

**2.02 SECURITY GATES**

- A. Security Gates and Barriers: Factory-fabricated, -assembled, and -tested devices, including components for satisfactory operation; capable of resisting specified impact when installed in foundations indicated on drawings.
- B. Material: Fabricated at factory w/Manufact. powder coating finish..

**2.03 AUTOMATED GATES AND BARRIERS**

- A. Automated Gates and Barriers - General: Having following characteristics as well as characteristics specified for each type:
  1. Comply with UL 325, Class I and ASTM F2200.
  2. Operation: opening in closing of metal swing gates.
  3. Material: pre-engineered metal gates with powder coated finish.
  4. Color: As selected from manufacturer's standard.
  5. Position Sensor: (3 sensor loops per gate..
  6. Control Type: Radio transmit.
  7. Detection Systems: [ ]].
    - a. Two (2) Photo-eye per gate. (6 total)
    - b. Two (2) Edge sensor per gate leaf. (12 total)
  8. Programming: Human Machine Interface Programmable Logic Controller (HMI PLC).
  9. Weight Limitations on Retractable Barriers: 15,000 pounds.
  10. Speed Limitations on Retractable Barriers: 15 mph.
  11. Electrical power connections and wiring for power unit and controls is specified in Section 260583.
  12. Main Operator Control Panel.
  13. Remote Operator Control Panel.
  14. Emergency Fast Operate (EFO).
  15. Battery Back-up.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verification of Conditions:
  1. Verify location of existing utilities, grades and conditions of substrate.
  2. Verify integration requirements with other site security equipment including but not limited to card readers, tire puncture devices, gates and other automated barrier systems.

**3.02 PREPARATION**

- A. Protect existing work from damage due to installation of this work.

**3.03 INSTALLATION**

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

**3.04 FIELD QUALITY CONTROL**

- A. See Section 014000 - Quality Requirements, for additional requirements.

**3.05 SYSTEM STARTUP**

- A. Provide manufacturer's field representative to observe systems startup.
- B. Prepare and start equipment in accordance with manufacturers' instructions and recommendations.
- C. Adjust for proper operation within manufacturer's published tolerances.

**3.06 CLEANING**

**3.07 CLOSEOUT ACTIVITIES**

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. Demonstrate proper operation of equipment to Owner's designated representative.
- C. Training: Train Owner's personnel on operation and maintenance of the barrier.
  - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
  - 2. Provide minimum of two hours of training.
  - 3. Location: At project site.

**3.08 PROTECTION**

- A. Protect installed units from subsequent construction operations.

**END OF SECTION**

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**SECTION 323300  
SITE FURNISHINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Skateboard Racks
- B. Bike Racks

**1.02 RELATED REQUIREMENTS**

- A. Section 033000 - Cast-in-Place Concrete: Bollard infill and underground encasement.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.
- D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.
- E. ASTM A536 - Standard Specification for Ductile Iron Castings 1984, with Editorial Revision (2019).

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, and maintenance information.
- C. Shop Drawings: Indicate plans for each unit or groups of units, elevations with model number, overall dimensions; construction, and anchorage details.

**1.05 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty against defects in materials or workmanship for ductile iron castings for a period of 10 years from Date of Substantial Completion.
- C. Provide manufacturer's Lifetime Warranty against defects in materials or workmanship for wood benches manufactured from solid teak.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Skateboard Racks:
  - 1. Boardloch- Brute 12 (double sided)
  - 2. Powder coated, Gray
- B. Bike Rack:
  - 1. Dero- Rolling Rack, RRH3
  - 2. Powder coated, Silver

**2.02 METAL FURNISHINGS**

- A. Metal Furnishings, General:
  - 1. Steel components: Plates, bars, and shapes complying with ASTM A36/A36M and tubing complying with ASTM A500/A500M; cleaned, treated, and powder-coated.
    - a. Color: As indicated on drawings.
  - 2. Hardware: Stainless steel.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

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- A. Verify that mounting surfaces, preinstalled anchor bolts, or other mounting devices are properly installed; and ready to receive site furnishing items.
- B. Do not begin installation until unacceptable conditions are corrected.

**3.02 INSTALLATION**

- A. Install site furnishings in accordance with approved shop drawings, and manufacturer's installation instructions.
- B. Provide level mounting surfaces for site furnishing items.

**END OF SECTION**

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**SECTION 323353  
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 cheek walls for exterior concrete stairs.
- D. Concrete benches.
- E. Concrete planters.
- F. Light pole bases.
- G. 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. Architect's Representative(s)
    - e. Cast-in-place architectural site concrete subcontractor.
    - f. Inspector of Record (IOR).
    - g. 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**

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- A. Product Data: For each type of product.
  - 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. 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. 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.
- D. 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.
  - 2. Comply with ACI 315, part B and CRSI requirements.
- E. 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.



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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.
- F. 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.
- G. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.
- H. Samples: For each of the following materials:
1. Form-facing panel.
  2. Form ties.
  3. Form liners.
  4. Coarse- and fine-aggregate gradations.
  5. Reveals
  6. One quart sample of sand and fine aggregate
  7. On quart sample of coarse aggregate
- I. Qualification Data: For manufacturer (batch plant).
- J. 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.
- K. 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.
  11. Joint-filler strips.
- L. 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.
- M. 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

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standard.

N. 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."
  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.

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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. Steps: Construct at least 6 linear feet of finished concrete steps/amphitheater seating with 3 risers minimum.
    - e. As-Cast Retarder Finishes: Mockups shall clearly demonstrate a consistent depth-of-cut for retarder finishes for Architect's review.
  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.
    - 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.

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### 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.
- 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

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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 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.
- I. 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.
- J. 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.
- K. 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.
- L. 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.
- M. 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.
- N. Provide new forms specifically purchased for this project. Reuse of forms from past projects or contractors stock will not be accepted.
- O. 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. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed, unless otherwise indicated.
- C. Low-Alloy-Steel Reinforcing Bars (for Welding): ASTM A 706/A 706M, Grade 60, deformed, unless otherwise indicated.
- D. 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."

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1. Where legs of wire bar supports contact forms, use CRSI Class 2, stainless-steel bar supports.

E. 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/IV, gray, unless white cement is required to achieve colors indicated. Supplement with the following:

B. Normal-Weight Aggregates: ASTM C 33, 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 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.

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. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
4. 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.

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## 2.05 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.
- D. Clear, Waterborne (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, 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.
- E. 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.

## 2.06 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. Rainguard International; Microseal(For use with VandIGuardTEN Anti-graffiti coating)

## 2.07 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.

## 2.08 JOINT DEVICES, FILLER MATERIALS AND OTHER ACCESSORY PRODUCTS

- A. Joint Filler at Exterior Sealed Joints: ASTM D 1751
  - 1. Lightweight, nonstaining, polyethylene closed cell expansion joint filler
    - a. Deck-O-Foam as manufactured by W.R.Meadows, Hampshire, Ill.
  - 2. Exterior Expansion- and Isolation-Joint-Filler Strips: See Division 32 Section "Concrete Paving Joint Sealants" for sealants for exterior joints at concrete pavements.

## 2.09 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.

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- 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.

## 2.10 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. 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.
  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.
- C. 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.



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- D. Slump Limit: [4 inches (100 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.
- E. 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 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.

## 2.11 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.

## 2.12 CONCRETE MIXING

- 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.

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- 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.

### 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

- 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.

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### **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.

### **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.

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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.
- 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

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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.
- 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.

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- 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

- 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. Fins and other projections exceeding specified limits on formed-surface irregularities should be removed. An even and consistent finish should remain.
- B. Smooth-Formed Finish is the general finish required for all formed integral-colored concrete, unless otherwise indicated. Rubbed finishes are unacceptable.

### 3.15 EXPOSED-AGGREGATE FINISHES

- A. Retarder Finish: Remove formwork without damaging edges or reveals.
  1. Ensure finish is even and no honeycombing or discoloration is apparent
  2. Edges shall not be chipped or spalled

### 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

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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:
  - 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

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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:
  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.



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- 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.
- 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**

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**SECTION 328400  
LANDSCAPE IRRIGATION**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. It is the intent of the specifications and drawings that the finished system is complete in every respect and shall be ready for operation satisfactory to the Owner.
- B. The work shall include all materials, labor, services, transportation, and equipment necessary to perform the work as indicated on the drawings, in these specifications, and as necessary to complete the contract.

**1.02 CONSTRUCTION DRAWINGS**

- A. All offsets, fittings, sleeves, etc. which may be required are not shown on the drawings. The Contractor shall carefully investigate the structural and finished conditions affecting the work and plan the work accordingly, furnishing such fittings, etc. as may be required to meet such conditions. The work shall be installed in such a manner as to avoid conflicts between irrigation systems, planting, and architectural features.
- B. All work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications. When an item is shown on the plans but not shown on the specifications or vice versa, it shall be deemed to be as shown on both. The Landscape Architect shall have final authority for clarification.
- C. The Contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering. Such obstructions or differences should be brought to the attention of the Landscape Architect as soon as detected. In the event this notification is not performed, the Irrigation Contractor shall assume full responsibility for any revision necessary.

**1.03 QUALITY ASSURANCE**

- A. Provide at least one English speaking person who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the manufacturer's recommended methods of installation and who shall direct all work performed under this section.
- B. Manufacturer's directions and detailed drawings shall be followed in all cases where the manufacturer of articles used in this contract furnish directions covering points not shown in the drawings and specifications.
- C. All local, municipal, and state laws, rules and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these specifications, and their provisions shall be carried out by the Contractor. Anything contained in these specifications shall not be construed to conflict with any of the above rules and regulations of the same. However, when these specifications and drawings call for or describe materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by the above rules and regulations, the provisions of these specifications and drawings shall take precedence.
- D. All materials supplied for this project shall be new and free from any defects. All defective materials shall be replaced immediately at no additional cost to Owner.
- E. Secure the required licenses and permits including payments of charges and fees, give required notices to public authorities and verify permits secured or arrangements made by others affecting the work of this section.

**1.04 SUBMITTALS**

- A. Water Pressure Test
  - 1. After award of contract and before any irrigation system materials are ordered from suppliers or delivered to the job site, submit to the Owner a written verification of the

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- existing water pressure on the project at each of the points of connection shown.
2. The water pressure test shall be performed to measure the dynamic water pressure at the point of connection at the maximum flow rate of the proposed irrigation system as shown on the point of connection note. Dynamic water pressure is when water is flowing through the point of connection. Static water pressure readings when water is not flowing, are not acceptable.
  3. Written dynamic water pressure test confirmation shall be made on the contractor's letterhead and include the flow rate during the test, the recorded water pressure, the date of the test and the time of the test.
- B. Material List:
1. After award of contract and before any irrigation system materials are ordered from suppliers or delivered to the job site, submit to the Owner a complete list of all irrigation system materials, or processes proposed to be furnished and installed as part of this contract.
  2. The submittal materials list shall include the following information:
    - a. A title sheet with the job name, the contractor's name, contractor's address and telephone number, submittal date and submittal number.
    - b. An index sheet showing the item number (e.g. 1,2,3, etc.); an item description (e.g. sprinkler head); the manufacturer's name (e.g. Hunter Industries); the item model number (e.g. I-40-ADV/36V); and the page(s) in the submittal set that contain the catalog cuts.
    - c. The catalog cuts shall be one or two pages copied from the most recent manufacturer's catalog that indicate the product submitted. Do not submit parts lists, exploded diagrams, price lists or other extra information.
    - d. The catalog cuts shall clearly indicate the manufacturer's name and the item model number. The item model number, all specified options and specified sizes shall be circled on the catalog cuts.
    - e. Submittals for equipment indicated on the legend without manufacturer names, or "as approved", shall contain the manufacturer, Class or Schedule, ASTM numbers and/or other certifications as indicated in these specifications.
  3. Submittal materials list format requirements:
    - a. Submittals shall be provided as one complete package for the project in electronic pdf format. Multiple partial submittals will not be reviewed.
    - b. Submittal package shall have all pages numbered in the lower right hand corner. Page numbers shall correspond with submittal index.
    - c. Re-submitted packages must be revised to include only the equipment being re-submitted. Equipment previously reviewed and accepted shall not be re-submitted in the materials list/index sheet or in the catalog cut sheet package.
- C. Substitutions: If the Irrigation Contractor wishes to substitute any equipment or materials for those equipment or materials listed on the irrigation drawings and specifications, he may do so by providing the following information to the Landscape Architect or Owner's authorized representative for approval.
1. Provide a written statement indicating the reason for making the substitution.
  2. Provide catalog cut sheets, technical data, and performance information for each substitute item.
  3. Provide in writing the difference in installed price if the item is accepted.
- D. The Landscape Architect or Owner's authorized representative will allow no substitutions without prior written acceptance
- E. No substitutions of pump manufacturers, distributors or assemblies will be accepted.
- F. Manufacturer's warranties shall not relieve the Contractor of his liability under the guarantee. Such warranties shall only supplement the guarantee.
- G. The Landscape Architect or Owner's authorized representative will not review the submittal package unless provided in the format described above.

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### 1.05 EXISTING CONDITIONS

- A. Verify and be familiar with the locations, size and detail of points of connection provided as the source of water, electrical supply, and ethernet connection to the irrigation system.
- B. Irrigation design is based on the available static water pressure shown on the drawings. Contractor shall verify static water on the project prior to the start of construction. Should a discrepancy exist, notify the Landscape Architect and Owner's authorized representative prior to beginning construction.
- C. Prior to cutting into the soil, locate all cables, conduits, sewer septic tanks, and other utilities as are commonly encountered underground, and take proper precautions not to damage or disturb such improvements. If a conflict exists between such obstacles and the proposed work, the Contractor shall promptly notify the Landscape Architect and Owner who will arrange for relocations. The Contractor will proceed in the same manner if a rock layer or any other such conditions are encountered.
- D. Protect all existing utilities and features to remain on and adjacent to the project site during construction. Repair, at its own cost, all damage resulting from his operations or negligence.
- E. The Irrigation Contractor shall coordinate with the General Contractor for installation of required sleeving as shown on the plans prior to paving operations.
- F. Verify and be familiar with the existing irrigation systems in areas adjacent to and within the Project area of work.
- G. Protect all existing irrigation systems, in areas adjacent to and within the project area of work, from damage due to his operations.
- H. Notify Owner's Representative if any existing system is temporarily shut off, capped or modified. Provide 48-hour notice, prior to turning off or modifying any existing irrigation system.
- I. Repair or replace all existing irrigation systems, in areas adjacent to and within the project area of work, damaged by the construction of this project. Adjacent irrigation systems shall be made completely operational and provide complete coverage of the existing landscaped areas. All repairs shall be complete to the satisfaction of the Owner's Representative.
- J. Provide bore holes under any existing pavement or paving encountered for the required lateral, mainline and low voltage control wire sleeving. Bore holes under 2 inches in diameter and smaller shall be made with a BulletMole® underground boring tool as manufactured by Dimension Tools, LLC (Contact telephone number (888)-650-5554 or at [www.bulletmole.com](http://www.bulletmole.com)). Bore holes larger than 2 inches in diameter shall be made with an approved mechanical boring tool. No air jacking or hydraulic boring of any kind shall be allowed.

### 1.06 INSPECTIONS

- A. The Contractor shall permit the Landscape Architect and Owner's authorized representative to visit and inspect at all times any part of the work and shall provide safe access for such visits.
- B. Where the specifications require work to be tested by the Contractor, it shall not be covered over until accepted by the Landscape Architect, Owner's authorized representative, and/or governing agencies. The Contractor shall be solely responsible for notifying the Landscape Architect, Owner, and governing agencies, a minimum of 48 hours in advance, where and when the work is ready for testing. Should any work be covered without testing or acceptance, it shall be, if so ordered, uncovered at the Contractor's expense.
- C. Inspections will be required for the following at a minimum:
  - 1. Pre-construction meeting.
  - 2. System layout.
  - 3. Pressure test of irrigation mainline (Four hours at 125 PSI or 120% of static water pressure, whichever is greater.) Mainline pressure loss during test shall not exceed 2 PSI.
  - 4. Coverage test of irrigation system. Test shall be performed prior to any planting.
  - 5. Final inspection prior to start of maintenance period.
  - 6. Final acceptance prior to turnover.

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- D. Site observations and testing will not commence without the field record drawings as prepared by the Irrigation Contractor. Record drawings must be complete and up to date for each site visit.
- E. Work that fails testing and is not accepted will be retested. Hourly rates and expenses of the Landscape Architect, Owner's authorized representative, and governing agencies for re-inspection or retesting will be paid by the Irrigation Contractor at no additional expense to Owner.

**1.07 STORAGE AND HANDLING**

- A. Use all means necessary to protect irrigation system materials before, during, and after installation and to protect the installation work and materials of all other trades. In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the Landscape Architect and Owner and at no additional cost to the Owner.
- B. Exercise care in handling, loading, unloading, and storing plastic pipe and fittings under cover until ready to install. Transport plastic pipe only on a vehicle with a bed long enough to allow the pipe to lay flat to avoid undue bending and concentrated external load.

**1.08 CLEANUP AND DISPOSAL**

- A. Dispose of waste, trash, and debris in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction. Bury no such waste material and debris on the site. Burning of trash and debris will not be permitted. Remove and dispose of rubbish and debris at frequent intervals or when ordered to do so by the Owner's authorized representative.
- B. At the time of completion the entire site will be cleared of tools, equipment, rubbish and debris which shall be disposed of off-site in a legal disposal area.

**1.09 TURNOVER ITEMS**

- A. Record Drawings:
  - 1. Record accurately on one set of drawings all changes in the work constituting departures from the original contract drawings and the actual final installed locations of all required components as shown below.
  - 2. The record drawings shall be prepared to the satisfaction of the Owner. Prior to final inspection of work, submit record drawings to the Landscape Architect or Owner's authorized representative.
  - 3. All record drawings shall be prepared using AutoCAD 2020 drafting software and the original irrigation drawings as a base. No manual drafted record drawings shall be acceptable. The Contractor may obtain digital base files from the Landscape Architect or Owner's authorized representative.
  - 4. If the Contractor is unable to provide the AutoCAD drafting necessary for the record drawings the irrigation designer does provide record drawing drafting as a separate service.
  - 5. Prior to final inspection of work, submit record drawings plotted onto vellum sheets for review by the Landscape Architect or Owner's authorized representative. After acceptance by the Landscape Architect, City Inspector or Owner's authorized representative re-plot the record drawings onto reproducible Mylar sheets. The Contractor shall also provide record drawing information on a digital AutoCAD Release 2020 drawing file. All digital files shall be provided on a compact disc (CD) clearly marked with the project name, file descriptions and date.
    - a. Record drawing information and dimensions shall be collected on a day-to-day basis during the installation of the pressure mainline to fully indicate all routing locations and pipe depths. Locations for all other irrigation equipment shall be collected prior to the final inspection of the work.
    - b. Two dimensions from two permanent points of reference such as buildings, sidewalks, curbs, streetlights, hydrants, etc. shall be shown for each piece of irrigation equipment shown below. Where multiple components are installed with no reasonable reference point between the components, dimensioning may be made to

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the irrigation equipment. All irrigation symbols shall be clearly shown matching the irrigation legend for the drawings. All lettering on the record drawings shall be minimum 1/8 inch in size.

6. Show locations and depths of the following items:
    - a. Point of connection (including water POC, backflow devices, master control valves, flow sensors, etc.)
    - b. Routing of sprinkler pressure main lines (dimensions shown at a maximum of 100 feet along routing)
    - c. Isolation valves
    - d. Automatic remote control valves (indicate station number and size)
    - e. Quick coupling valves
    - f. Drip air relief and flush valves
    - g. Routing of control wires where separate from irrigation mainline
    - h. Irrigation controllers (indicate controller number and station count)
    - i. Related equipment (as may be directed)
- B. Controller Charts:
1. Provide one controller chart for each automatic controller. Chart shall show the area covered by the particular controller. The areas covered by the individual control valves shall be indicated using colored highlighter pens. A minimum of six individual colors shall be used for the controller chart unless less than six control valves are indicated.
  2. Landscape Architect or Owner's authorized representative must approve record drawings before controller charts are prepared.
  3. The chart is to be a reduced copy of the actual "record" drawing. In the event the controller sequence is not legible when the drawing is reduced, it shall be enlarged to a readable size.
  4. When completed and approved, the chart shall be hermetically sealed between two pieces of plastic, each piece being a minimum 20 mils in thickness.
- C. Operation and Maintenance Manuals:
1. Two individually bound copies of operation and maintenance manuals shall be delivered to the Landscape Architect or Owner's authorized representative at least 10 calendar days prior to final inspection. The manuals shall describe the material installed and the proper operation of the system.
  2. Each complete, bound manual shall include the following information:
  3. Index sheet stating Contractor's address and telephone number, duration of guarantee period, list of equipment including names and addresses of local manufacturer representatives.
    - a. Operating and maintenance instructions for all equipment.
    - b. Spare parts lists and related manufacturer information for all equipment.
- D. Equipment:
1. Supply as a part of this contract the following items:
    - a. Two (2) wrenches for disassembly and adjustment of each type of sprinkler head used in the irrigation system.
    - b. Three 30-inch sprinkler keys for manual operation of control valves.
    - c. Two keys for each automatic controller.
    - d. Two quick coupler keys with a 1" bronze hose bib, bent nose type with hand wheel and two coupler lid keys.
    - e. One valve box cover key or wrench.
    - f. Six extra sprinkler heads of each size and type.
    - g. For specified ball valves if required: One (1) 5-foot long valve handle, to fit the specified ball valves.
  2. The above equipment shall be turned over to Owner's authorized representative at the final inspection.

## 1.10 COMPLETION

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- A. At the time of the pre-maintenance period inspection, the Landscape Architect, Owner's authorized representative, and governing agencies will inspect the work, and if not accepted, will prepare a list of items to be completed by the Contractor. Punch list to be checked off by contractor and submitted to Landscape Architect or Owner's authorized representative prior to any follow-up meeting. This checked off list to indicate that all punch list items have been completed. At the time of the post-maintenance period or final inspection the work will be re-inspected and final acceptance will be in writing by the Landscape Architect, Owner's authorized representative, and governing agencies.
- B. The Owner's authorized representative shall have final authority on all portions of the work.
- C. After the system has been completed, the Contractor shall instruct Owner's authorized representative in the operation and maintenance of the irrigation system and shall furnish a complete set of operating and maintenance instructions.
- D. Any settling of trenches which may occur during the one-year period following acceptance shall be repaired to the Owner's satisfaction by the Contractor without any additional expense to the Owner. Repairs shall include the complete restoration of all damage to planting, paving or other improvements of any kind as a result of the work.

### 1.11 GUARANTEE

- A. The entire sprinkler system, including all work done under this contract, shall be unconditionally guaranteed against all defects and fault of material and workmanship, including settling of backfilled areas below grade, for a period of one (1) year following the filing of the Notice of Completion.
- B. Should any problem with the irrigation system be discovered within the guarantee period, it shall be corrected by the Contractor at no additional expense to Owner within ten (10) calendar days of receipt of written notice from Owner. When the nature of the repairs as determined by the Owner constitute an emergency (i.e. broken pressure line) the Owner may proceed to make repairs at the Contractor's expense. Any and all damages to existing improvement resulting either from faulty materials or workmanship, or from the necessary repairs to correct same, shall be repaired to the satisfaction of the Owner by the Contractor, all at no additional cost to the Owner.
- C. Guarantee shall be submitted on Contractors own letterhead as follows:
  - 1. GUARANTEE FOR SPRINKLER IRRIGATION SYSTEM
  - 2. We hereby guarantee that the sprinkler irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear and unusual abuse, or neglect excepted. We agree to repair or replace any defective material during the period of one year from date of filing of the Notice of Completion and also to repair or replace any damage resulting from the repairing or replacing of such defects at no additional cost to the Owner. We shall make such repairs or replacements within 10 calendar days following written notification by the Owner. In the event of our failure to make such repairs or replacements within the time specified after receipt of written notice from Owner, we authorize the Owner to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.
  - 3. PROJECT NAME:
  - 4. PROJECT LOCATION:
  - 5. CONTRACTOR NAME:
  - 6. ADDRESS:
  - 7. TELEPHONE:
  - 8. SIGNED:
  - 9. DATE:

## PART 2 MATERIALS

### 2.01 SUMMARY

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- A. Use only new materials of the manufacturer, size and type shown on the drawings and specifications. Materials or equipment installed or furnished that do not meet Landscape Architect's, Owner's, or governing agencies standards will be rejected and shall be removed from the site at no expense to the Owner.

**2.02 PIPE**

- A. Pressure supply lines 2 inches in diameter and up to 3 inches in diameter downstream of backflow prevention unit shall be Class 315 solvent weld PVC. Piping shall conform to ASTM D2241.
- B. Pressure supply lines 4 inches in diameter and larger downstream of the backflow unit shall be Class 200 bell and gasket PVC conforming to ASTM 2672.
- C. Non-pressure lines 3/4 inch in diameter and larger downstream of the remote control valve shall be SCH 40 solvent weld PVC conforming to ASTM D1785.

**2.03 METAL PIPE AND FITTINGS**

- A. Brass pipe shall be 85 percent red brass, ANSI, IPS Standard 125 pounds, Schedule 40 screwed pipe.
- B. Fittings shall be medium brass, screwed 125-pound class.
- C. Copper pipe and fittings shall be Type "K" sweat soldered, or brazed as indicated on the drawings.

**2.04 PLASTIC PIPE AND FITTINGS**

- A. Pipe shall be marked continuously with manufacturer's name, nominal pipe size, schedule or class, PVC type and grade, National Sanitation Foundation approval, Commercial Standards designation, and date of extrusion.
- B. All plastic pipe shall be extruded of an improved PVC virgin pipe compound in accordance with ASTM D2672, ASTM D2241 or ASTM D1785.
- C. All solvent weld PVC fittings shall be standard weight Schedule 40 (and Schedule 80 where specified on the irrigation detail sheet, all mainline fittings shall be Schedule 80 PVC) and shall be injection molded of an improved virgin PVC fitting compound. Slip PVC fittings shall be the "deep socket" bracketed type. Threaded plastic fittings shall be injection molded. All tees and ells shall be side gated. All fittings shall conform to ASTM D2464 and ASTM D2466.
- D. All threaded nipples shall be standard weight Schedule 80 with molded threads and shall conform to ASTM D1785.
- E. All solvent cementing of plastic pipe and fittings shall be a two-step process, using primer and solvent cement applied per the manufacturer's recommendations. Cement shall be of a fluid consistency, not gel-like or ropy. Solvent cementing shall be in conformance with ASTM D2564 and ASTM D2855.
- F. When connection is plastic to metal, female adapters shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be non-lead base Teflon paste, tape, or equal.
- G. All pressure mainlines installed with solvent weld PVC fittings shall be installed with concrete thrust blocking at all directional changes in the mainline routing. Concrete thrust blocking shall not be required when ductile iron fittings and mechanical restraints are specified.

**2.05 BELL AND GASKET FITTINGS**

- A. Fittings for bell and gasket pressure supply lines shall be ductile iron deep bell type. Fittings shall be manufactured of ductile iron, Grade 65-45-12 in accordance with ASTM A-536. Fitting gaskets shall be in accordance with ASTM F-477. All ductile iron fittings shall be manufactured with exterior lugs. Ductile iron fittings shall be as manufactured by Leemco, Inc., Corona, California.
- B. All tee fittings used to connect remote control valve assemblies and quick coupler assemblies to the mainline shall be ductile iron deep bell type. The outlet side of the tee or ell to the valve



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assembly shall be sized per the diameter of the largest valve in the assembly or a minimum of 2 inches. Ductile iron deep bell type reducers when used with bolt on links are allowable in lieu of reducing tee or ells. The PVC pipe to the valve assembly shall be secured to the ductile iron fitting using a joint restraint.

- C. All ductile iron fittings and all bell and gasket joints within fifty (50) feet of a directional change in the mainline shall be equipped with mechanical joint restraints. The joint restraint shall be capable of securing the PVC pipe directly to the lugs on the ductile iron fittings without the use of bolts, links and adapters. The joint restraint shall be capable of securing PVC pipe to PVC pipe and PVC pipe to ring joint isolation valves without the use of threaded linkages. Joint restraints shall be as manufactured by Leemco, Inc., Corona, California.

## 2.06 VALVES

- A. Ball Valves:
  1. Ball valves shall be of the manufacturer, size, and type indicated on the drawings.
  2. All ball valves shall have a minimum working pressure of not less than 150 PSI and shall conform to AWWA standards.
- B. Quick Coupler Valves:
  1. Quick coupler valves shall be of the manufacturer, size, and type indicated on the drawings.
  2. Quick coupler valves shall be brass with a wall thickness guaranteed to withstand normal working pressure of 150 psi without leakage. Valves shall have 1" female threads opening at base, with two-piece body. Valves to be operated only with a coupler key, designed for that purpose. Coupler key is inserted into valve and a positive, watertight connection shall be made between the coupler key and valve.
- C. Automatic Control Valves:
  1. Automatic control valves shall be of the manufacturer, size, and type indicated on the drawings.
  2. Automatic control valves shall be electrically operated.
  3. Provide Christy's valve ID tags for each remote control valve with valve number.

## 2.07 VALVE BOXES

- A. Valve boxes shall be fabricated from a durable, weather-resistant plastic material resistant to sunlight and chemical action of soils.
- B. The valve box cover shall be secured with a hidden latch mechanism or bolts.
- C. Valve box extensions shall be by the same manufacturer as the valve box.
- D. The plastic irrigation valve box cover shall be an overlapping type.
- E. Automatic control valve, master valve, and flow sensor boxes shall be 17"x11"x12" 'nominal' rectangular size. Valve boxes for drip valve assemblies shall be Jumbo valve boxes size as required to fit assemblies. Valve box covers shall be marked "RCV" with the valve identification number, or "MV", "FS" "heat branded" onto the cover in 1-1/4 inch high letters / numbers.
- F. Quick coupler and ball valve boxes shall be 10" circular size. Valve box covers shall be marked with "QCV" or "BV" "heat branded" onto the cover in 1-1/4 inch high letters.

## 2.08 AUTOMATIC CONTROLLER

- A. Automatic controller shall be of the manufacturer, size, and type indicated on the drawings.
- B. Controller enclosure shall be of the manufacturer, size, and type indicated on the drawings.
- C. Controller shall be grounded according to local codes using equipment of the manufacturer, size, and type indicated on the drawings; or as required by local codes and ordinances.

## 2.09 ELECTRICAL

- A. All electrical equipment shall be NEMA Type 3, waterproofed for exterior installations.
- B. All electrical work shall conform to local codes and ordinances.

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## 2.10 LOW VOLTAGE CONTROL WIRING

- A. Remote control wire shall be direct-burial AWG-UF type, size as indicated on the drawings, and in no case smaller than 14 gauge.
- B. Connections shall of the manufacturer, size, and type indicated on the drawings.
- C. Common wires shall be white in color. Control wires shall be red (where two or more controllers are used, the control wires shall be a different color for each controller. These colors shall be noted on the "Record Drawings" plans located on controller door).
- D. Ground wires shall be green in color or bare copper and in no case smaller than 6 gauge.

## 2.11 IRRIGATION HEADS AND DRIP EMITTERS

- A. Irrigation heads and drip emitters shall be of the manufacturer, size, type, with radius of throw, operating pressure, and discharge rate indicated on the drawings.
- B. Irrigation heads and drip emitters shall be used as indicated on the drawings.

## 2.12 DRIP IRRIGATION EQUIPMENT

- A. Drip tubing equipment such as flush valves, wye strainers, and pressure regulators shall be of the manufacturer, size, and type indicated on the drawings.

## 2.13 MISCELLANEOUS EQUIPMENT

- A. Landscape Fabric:
  - 1. Landscape fabric for valve box assemblies shall be 5.0- oz. weight woven polypropylene weed barrier. Landscape fabric shall have a burst strength of 225 PSI, a puncture strength of 60 lbs. and capable of water flow of 12 gallons per minute per square foot.
  - 2. Type: DeWitt Pro 5 Weed Barrier or approved equal.
- B. Equipment such as flow sensors, rain sensors, flush valves, wye strainers, and master valves shall be of the manufacturer, size and type indicated on the drawings.

## PART 3 EXECUTION

### 3.01 SITE CONDITIONS

- A. Inspections:
  - 1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
  - 2. Verify that irrigation system may be installed in strict accordance with all pertinent codes and regulations, the original design, the referenced standards, and the manufacturer's recommendations.
- B. Discrepancies:
  - 1. In the event of discrepancy, immediately notify the Landscape Architect or Owner's authorized representative.
  - 2. Do not proceed with installation in areas of discrepancy until all discrepancies have been resolved.
- C. Grades:
  - 1. Before starting work, carefully check all grades to determine that work may safely proceed, keeping within the specified material depths with respect to finish grade.
  - 2. Final grades shall be accepted by the Engineer before work on this section will be allowed to begin.
- D. Field Measurements:
  - 1. Make all necessary measurements in the field to ensure precise fit of items in accordance with the original design. Contractor shall coordinate the installation of all irrigation materials with all other work.
  - 2. All scaled dimensions are approximate. The Contractor shall check and verify all size dimensions prior to proceeding with work under this section.

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3. Exercise extreme care in excavating and working near existing utilities. Contractor shall be responsible for damages to utilities, which are caused by his operations or neglect.
- E. Diagrammatic Intent:
1. The drawings are essentially diagrammatic. The size and location of equipment and fixtures are drawn to scale where possible. Provide offsets in piping and changes in equipment locations as necessary to conform with structures and to avoid obstructions or conflicts with other work at no additional expense to Owner.
- F. Layout:
1. Prior to installation, the Contractor shall stake out all pressure supply lines, routing and location of sprinkler heads, valves, backflow preventer, and automatic controller.
  2. Layout irrigation system and make minor adjustments required due to differences between site and drawings. Where piping is shown on drawings under paved areas, but running parallel and adjacent to planted areas, install the piping in the planted areas.
- G. Water Supply:
1. Connections to, or the installation of, the water supply shall be at the locations shown on the drawings. Minor changes caused by actual site conditions shall be made at no additional expense to Owner.
- H. Electrical Service:
1. Connections to the electrical supply shall be at the locations shown on the drawings. Minor changes caused by actual site conditions shall be made at no additional expense to Owner.
  2. Contractor shall make electrical connections to the irrigation controller. Electrical power source to controller locations shall be provided by others.
  3. Contractor shall make electrical connections to the irrigation controller.

### 3.02 TRENCHING

- A. Excavations shall be straight with vertical sides, even grade, and support pipe continuously on bottom of trench. Trenching excavation shall follow layout indicated on drawings to the depths below finished grade and as noted. Where lines occur under paved area, these dimensions shall be considered below subgrade.
- B. Provide minimum cover of 18 inches on pressure supply lines 2 ½ inches and smaller.
- C. Provide minimum cover of 24 inches on pressure supply lines 3 inches and larger.
- D. Provide minimum cover of 18 inches for control wires within planters.
- E. Provide minimum cover of 24 inches for control wires within sleeves below paving.
- F. Provide minimum cover of 36 inches on pressure supply lines under vehicular travel ways.
- G. Provide minimum cover of 12 inches for non-pressure lines.
- H. Pipes installed in a common trench shall have a 4-inch minimum space between pipes.

### 3.03 THRUST BLOCKS

- A. Thrust blocks must be constructed of Class "B" concrete.
- B. Thrust blocks shall be poured against undisturbed site soil.
- C. PVC fitting joints shall be kept free of concrete. Do not encase fitting in concrete.
- D. Thrust blocking shall be sized to provide the minimum bearing areas as shown below. Bearing areas indicated have been calculated for Class 200 PVC pipe at a test pressure of 150 PSI in soil with 2,000 PSI bearing capacity. Increase thrust block sizing as necessary for varying soil conditions.
  1. Provide a minimum thrust block bearing area of 2.0 square feet on all bends (all degrees) and tees installed on pressure supply lines 3 inches and smaller.

### 3.04 BACKFILLING

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- A. Backfill material on all lines shall be the same as adjacent soil free of debris, litter, and rocks over 1/2 inches in diameter.
- B. Backfill shall be tamped in 4-inch layers under the pipe and uniformly on both sides for the full width of the trench and the full length of the pipe. Backfill materials shall be sufficiently damp to permit thorough compaction, free of voids. Backfill shall be compacted to dry density equal to adjacent undisturbed soil and shall conform to adjacent grades.
- C. Flooding in lieu of tamping is not allowed.
- D. Under no circumstances shall truck wheels be used to compact backfill.
- E. Provide sand backfill over and under all piping under paved areas.

### 3.05 PIPING

- A. Piping under existing pavement may be installed by jacking, boring, or hydraulic driving. No hydraulic driving is permitted under asphalt pavement.
- B. Cutting or breaking of existing pavement is not permitted.
- C. Carefully inspect all pipe and fittings before installation, removing dirt, scale, burrs, and reaming. Install pipe with all markings up for visual inspection and verification.
- D. Remove all dented and damaged pipe sections.
- E. All lines shall have a minimum clearance of 4 inches from each other and 12 inches from lines of other trades.
- F. Parallel lines shall not be installed directly over each other.
- G. In solvent welding, use only the specified primer and solvent cement and make all joints in strict accordance with the manufacturer's recommended methods including wiping all excess solvent from each weld. Allow solvent welds at least 15 minutes setup time before moving or handling and 24 hours curing time before filling.
- H. PVC pipe shall be installed in a manner, which will provide for expansion and contraction as recommended by the pipe manufacturer.
- I. Center load all plastic pipe prior to pressure testing.
- J. All threaded plastic-to-plastic connections shall be assembled using Teflon tape or Teflon paste.
- K. For plastic-to-metal connections, work the metal connections first. Use a non-hardening pipe dope on all threaded plastic-to-metal connections, except where noted otherwise. All plastic-to-metal connections shall be made with plastic male adapters.

### 3.06 CONTROLLER

- A. The exact location of the controller shall be approved by the Landscape Architect or Owner's authorized representative before installation. The electrical service shall be coordinated with this location.
- B. The Irrigation Contractor shall be responsible for the final electrical hook up to the irrigation controller.
- C. The irrigation system shall be programmed to operate during the periods of minimal use of the design area.

### 3.07 CONTROL WIRING

- A. Low voltage control wiring shall occupy the same trench and shall be installed along the same route as the pressure supply lines whenever possible.
- B. Where more than one wire is placed in a trench, the wiring shall be taped together in a bundle at intervals of 10 feet. Bundle shall be secured to the mainline with tape at intervals of 20 feet.
- C. All connections shall be of an approved type and shall occur in a valve box. Provide an 18-inch service loop at each connection.

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- D. An expansion loop of 12 inches shall be provided at each wire connection and/or directional change, and one of 24 inches shall be provided at each remote control valve.
- E. A continuous run of wire shall be used between a controller and each remote control valve. Under no circumstances shall splices be used without prior approval.

### **3.08 VALVES**

- A. Automatic control valves, quick coupler, and ball valves are to be installed in the approximate locations indicated on the drawings.
- B. Valve shall be installed in shrub areas whenever possible.
- C. Install all valves as indicated in the detail drawings.
- D. Valves to be installed in valve boxes shall be installed one valve per box.
- E. Provide valve ID tags for each remote control valve with valve number.

### **3.09 VALVE BOXES**

- A. Valve boxes shall be installed in shrub areas whenever possible.
- B. Each valve box shall be installed on a foundation of 3/4 inch gravel backfill, 3 cubic feet minimum. Valve boxes shall be installed with their tops 1/2 inch above the surface of surrounding finish grade in lawn areas and 2 inches above finish grade in ground cover areas.

### **3.10 IRRIGATION HEADS AND DRIP EMITTERS**

- A. Irrigation heads and drip emitters shall be installed as indicated on the drawings.
- B. Spacing of heads and inline drip tubing shall not exceed maximum indicated on the drawings.
- C. Riser nipples shall be of the same size as the riser opening in the sprinkler body.

### **3.11 BACKFLOW PREVENTION UNITS**

- A. Backflow Prevention Units shall be installed as indicated on the drawings. The backflow prevention unit shall be installed in accordance with the requirements set forth by local codes.
- B. The exact location of the backflow device shall be approved by the Landscape Architect or owner's authorized representative before installation.
- C. The contractor shall be responsible for the testing and certification of the backflow device for proper operation. Testing and certification shall be performed by a state qualified backflow tester.

### **3.12 MISCELLANEOUS EQUIPMENT**

- A. Install all assemblies specified herein according to the respective detail drawings or specifications, using best standard practices.
- B. Quick coupler valves shall be set approximately 18 inches from walks, curbs, header boards, or paved areas where applicable.
- C. Install devices such as rain sensors, flush valves, master valves, and flow sensors as indicated on the drawings and as recommended by the manufacturer.

### **3.13 FLUSHING THE SYSTEM**

- A. Prior to installation of irrigation heads, the valves shall be opened and a full head of water used to flush out the lines and risers.
- B. Irrigation heads shall be installed after flushing the system has been completed.

### **3.14 ADJUSTING THE SYSTEM**

- A. Contractor shall adjust valves, align heads, and check the coverage of each system prior to coverage test.
- B. If it is determined by the Landscape Architect or Owner's authorized representative that additional adjustments or nozzle changes will be required to provide proper coverage, all necessary changes or adjustments shall be made prior to any planting.

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- C. The entire system shall be operating properly before any planting operations commence.
- D. Automatic control valves are to be adjusted so that the irrigation heads and drip emitters operate at the pressure recommended by the manufacturer.

**3.15 TESTING AND OBSERVATION**

- A. Do not allow or cause any of the work of this section to be covered up or enclosed until it has been observed, tested and accepted by the Landscape Architect, Owner, and governing agencies.
- B. The Contractor shall be solely responsible for notifying the Landscape Architect, Owner, and governing agencies, a minimum of 48 hours in advance, where and when the work is ready for testing.
- C. When the sprinkler system is completed, the Contractor shall perform a coverage test of each system in its entirety to determine if the water coverage for the planted areas is complete and adequate in the presence of the Landscape Architect.
- D. The Contractor shall furnish all materials and perform all work required to correct any inadequacies of coverage due to deviations from the plans, or where the system has been willfully installed as indicated on the drawings when it is obviously inadequate, without bringing this to the attention of the Landscape Architect. This test shall be accepted by the Landscape Architect and accomplished before starting any planting.
- E. Areas to be maintained for the formal maintenance period shall start maintenance at the same time, as directed by the Landscape Architect, Owner, and governing agencies. Partial areas will not be released into maintenance prior to completion of items listed in the pre-maintenance review. The maintenance period may not be phased.
- F. If, after the maintenance review, the irrigation systems are not accepted by the Landscape Architect, the contractor shall reimburse the Architect for additional site visits, or additional time required to review work. All additional time will be billed at the Architect's hourly rate and will be paid for by the contractor at no additional cost to the owner.
- G. Final inspection will not commence without record drawings as prepared by the Irrigation Contractor.

**3.16 MAINTENANCE**

- A. During the maintenance period the Contractor shall adjust and maintain the irrigation system in a fully operational condition providing complete irrigation coverage to all intended plantings.

**3.17 COMPLETION CLEANING**

- A. Clean up shall be made as each portion of the work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be swept, and any damage sustained on the work of others shall be repaired to original conditions.

**END OF SECTION**

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**SECTION 329119  
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**

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**SECTION 329300  
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. Sod
- J. Pruning
- K. Tree stabilization.
- L. Root Barriers.

**1.02 RELATED REQUIREMENTS**

- A. Division 31 Section Site Clearing
- B. Division 32 Section Finish Grading
- C. Division 32 Section Landscape Irrigation
- D. Division 32 Section Landscape Maintenance
- E. 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. Root Zone: Imported specialty soil manufactured offsite by Gail Materials to be placed beneath turf fields.
- C. 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.
- D. 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.
- E. Finish Grade: Elevation of finished surface of planting soil.
- F. 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)
- G. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

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- H. 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.
- I. Planting Soil: Native or imported topsoil; mixed with soil amendments.
- J. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
- K. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- L. 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).
    - b. Fertilizer (as identified in Agronomic Soils Report).
    - c. Plant Tablets.
    - d. Stakes and Guys.
    - e. Tree Ties and Vine Ties.
    - f. Hydroseed Materials.
    - g. Mulch.
    - h. Filter Fabric.
    - i. Drainage Materials.
    - j. Accessory Material.
    - k. Other soil additives per Agronomic Soils Report.
    - l. 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.
    - m. 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.

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- n. 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.
    - 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

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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.
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

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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.
    - 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.

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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.
  - 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.

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- 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:
    - 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. Aguiñaga Fertilizer Co., Inc., Irvine, CA, 949-786-9558.
  - 2. Best Fertilizer Co., Lathrop, CA.



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3. Conwed Designscape, Ladyscape, MI, 714-532-5548/800-833-4798.
4. Deep Root Corporation, Burlington, CA, 800-458-7668.
5. Fore Sight Products, Inc., Commerce City, CO, 800-925-5360.
6. Gail Materials, Corona, CA, 951-664-6106.
7. Landscape Forms, represented by David Silverman & Associates, 818-541-6691.
8. Mirafi, Inc., Charlotte, NC 800-438-1855, represented by James Heidt & Associates, Montrose, CA, 818-248-9677/800-233-0512.
9. NDS Drainage Products, 800-726-1998.
10. Quality Turf, Temecula, CA, 800-721-4800.
11. Pacific Sod, Camarillo, CA, 800-762-3027.
12. Permaloc Corporation, Holland, MI, 616-399-9600.
13. S&S Seeds, Camarillo, CA, 805-684-0436.
14. Soil and Plant Laboratory, Inc., Orange, CA, 714-282-8777.
15. Southern California Organic Fertilizer Company, El Monte, CA, 714-750-3830.
16. Southland Sod Farms, Port Hueneme, CA, 805-488-3585.
17. Stabilizer, Inc., Phoenix, AZ, 602-952-8009/800-336-2468.
18. V.I.T. Company, Escondido, CA, 760-480-6702.
19. West Coast Turf, Las Vegas, NV, 800-649-8873.
20. Whitecap, Inc., Santa Ana, CA, 714-258-3300.
21. Whittier Fertilizer, Pico Rivera, CA, 310-699-3461.
22. EPIC Plastics, Cerritos, CA, 562-403-3848.
23. Wallace Labs, El Segundo, CA, 310-615-0116.
24. 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.

## 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.

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- d. 50-lbs Agricultural Gypsum, per 1,000 square feet.
3. Actual amendment rates and type shall be per soil test recommendations.
4. 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.
5. Soil Amendments:
  - a. 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.
6. 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) Peat Moss: Sphagnum peat moss, Canadian or European variety, free from alkali.
    - 4) Soil Sulfur: First quality commercial grade.
    - 5) Ferrous Iron Sulfate: Chelated first quality commercial grade.
    - 6) Agricultural Gypsum: First quality commercial grade.
    - 7) Best "Ammonium Phosphate" 16-20-0 with net less than 16% total nitrogen, 20% available phosphoric acid and 0% soluble potash.
    - 8) Good Humus.
    - 9) Root Hormone: Super Thrive.

## 2.04 PLANT MATERIALS

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- 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.
  - 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 bromegrass.
    - 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.

## 2.06 MISCELLANEOUS LANDSCAPE MATERIALS:

- A. Tree Stakes: Provide stakes of sound new lodgepole pine 2 inch minimum diameter for 15 gallon to 24 inch box size trees; 3 inch minimum diameter for 36 inch box and larger. Lodge pole 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.
- B. 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.
  - C. Vine Ties: Plastic vine ties, as specified on plans.
  - D. Guying Materials
    - 1. At On-Grade Planting:
      - a. Anchor System: Duckbill Earth Anchor System, as manufactured by MacLean Civil Products, Inc.
        - 1) Tree sizes, 15 Gallon to 24-in box: Model 40 DTS.
        - 2) Tree sizes, 36-inch box to 48-inch box: Model 68 DTS.
      - b. Hose: White neoprene hose, 3/4-inch diameter, covering the entire length of wire rope.
    - 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.
      - d. Turnbuckle: galvanized steel type.
        - 1) 3/8 inches by 3 inches long
  - E. Headers and Edging
    - 1. Concrete edger: Dimension as specified on plans, poured in place concrete edger, color per plan.
  - F. Mulch
    - 1. 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.
    - 2. Weed Control Fabric: Place Mirafi Mirascope landscape fabric below rock mulch or as shown on drawings. Overlap all seams 12" minimum and pin down every 36" typical. Mirascope fabric available from: Towns & Associates, 800-222-6036
  - G. Root Control Barriers: High-density polypropylene root control planter. Acceptable products include:
    - 1. Deep Root; Deep Root Corporation.
    - 2. Size as specified on drawings.
  - H. 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.
    - 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.
  - I. Sand: Washed plaster sand.
  - J. 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.
  - K. Staples: 11 gage with 1-inch top and 6-inch legs.

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- L. Sod Pegs: 1-inch square by 6-inch long pine or 6-inch lengths of lath.
- M. 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 Landscape 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. Agronomic Soils Testing
      - 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.

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- 5) Submit testing laboratory's interpretation, recommendations, and comments to Architect within 14 days after the completion of rough grading.
- d. 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.
- e. 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 ½ inch (13mm) in any dimension and sticks, roots, rubbish and other deleterious matter per Division 32 "Landscape Grading".
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 (8) inches of planting areas to evenly distribute the amendments and conditioners into the soil.

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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.
  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.
- B. Preparation for Lawn Areas: Limit preparation to areas which will be planted promptly after preparation.
1. Prepare planting area as described in 3.05 A.
  2. 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

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grades. Establish smooth uniform surface. Limit fine grading to areas which can be planted immediately after grading.

3. 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.
4. Restore lawn areas to specified conditions if eroded or otherwise disturbed after fine grading and prior to planting.

### 3.06 JUTE MESH

- A. Make check slots before the netting is rolled out. Dig a narrow trench across the slope perpendicular to the direction of the flow. Fold jute, the same length as the trench, and press together. Location of check slots shall be a maximum of 50 feet apart.
- B. Installation: Roll netting parallel to slope contours. The netting shall completely cover all areas as indicated on Contract Drawings. Overlaps shall be ample and well stapled.
  1. Lay netting smoothly, and in continuous contact with the soil surface at all points.
  2. Install without stretching. Where one roll of netting ends and a second roll starts, the up slope piece shall be brought over the buried end of the second roll so that there is a 12-inch overlap. Where two or more widths of netting are applied, side by side, the overlap shall be not less than 3 inches.
  3. Staple overlapping edges that run parallel to the direction of the flow at 2-inch intervals. Outside edges, centers, and overlaps on banks shall be stapled across the slope at 6-inch intervals.
  4. Top dress jute netting area with a thin layer of topsoil. After the top dressing, the yarns shall still be visible.
  5. Spread loose topsoils over outside edges of netting to allow for smooth entry of water.
  6. Clods that hold the jute off the ground shall be stamped into the soil. Force jute netting down into depressions and hold there with a staple.
  7. Install plant material through netting.
  8. Maintenance: Maintain jute netting until work on the Project has been completed and accepted and during the 90-day maintenance period. Maintenance shall consist of the repair of eroded areas and the repair or replacement and re-stapling of loose or undermined netting. Replace damaged planting materials as required.
  9. Install jute netting in all areas of 30 percent slope or greater.

### 3.07 SOD

- A. Sod shall be laid with closely fitted joints on a smooth, level surface which has been prepared as previously specified. Ends of strips shall be staggered. On irregular areas, sod shall be laid in both directions from the longest straight line that can be drawn through the area.
- B. After a light initial watering immediately after installation, the sod shall be rolled to eliminate all irregularities.
- C. After compaction, the sodded area shall be wetted to a soil depth of at least 8 inches.
- D. Sod shall be as specified on the Contract Drawings
- E. Protect sod from pedestrian traffic for 21 days and from sports activity for 6 weeks.
- F. Sod is to be rolled minimum two times or as often as required in two directions with a water ballast roller to remove variations in grade. Sand infill all depresses. Sand to comply with turf manufacturer recommendations.
- G. Sod is to be machine placed from "Big Rolls".

### 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.



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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.
- 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, (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 and rates are 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.

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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.
- 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.
- T. Planting Vines: Plant in accordance with details. Attach vine to vertical elements 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

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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 Landscape 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.
  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**

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**SECTION 333113  
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 existing onsite sanitary sewer system..
- C. Cleanout access.

**1.02 RELATED REQUIREMENTS**

- A. Section 312316 - Excavation: Excavating of trenches.
- B. Section 312323 - 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. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings 2021.
- B. Standard Specifications for Public Works Construction (Greenbook); current edition.

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating pipe, pipe accessories .
- C. Project Record Documents:
  - 1. Record location of pipe runs, connections, manholes, cleanouts, and invert elevations.

**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; inside nominal diameter as indicated, bell and spigot style rubber gasket joints.
- C. 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. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Sewer Service " in large letters. Coordinate with Section 312316.13.

**2.03 BEDDING AND COVER MATERIALS**

- A. Pipe Bedding Material: As specified in Construction Drawings.
- B. Pipe Cover Material: As specified in Construction Drawings.

**2.04 CLEANOUTSS**

- A. Cleanout: As specified in Construction Drawings.

**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.

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### 3.03 TRENCHING

- A. See Construction Drawings 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 trace wire 6 inches above top of pipe; coordinate with Section 312316.13.

### 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 014000.
- 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 Greenbook Section 306-7.8.
- D. Infiltration Test: Test in accordance with Greenbook Section 306-7.8.
- E. Deflection Test: Test in accordance with Greenbook Section 306-7.8.

### 3.07 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

**END OF SECTION**

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**SECTION 334211  
STORMWATER GRAVITY PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Storm drainage piping, fittings, and accessories.
- B. Connection of drainage system to existing onsite storm drain system.
- C. Catch basins, Plant area drains, and Paved area drainage.

**1.02 RELATED REQUIREMENTS**

- A. Section 312316 - Excavation: Excavating of trenches.
- B. Section 312323 - 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. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings 2021.
- B. Standard Specifications for Public Works Construction (Greenbook); current edition.

**1.05 SUBMITTALS**

- A. See Section 013000 - 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.

**PART 2 PRODUCTS**

**2.01 STORM DRAINAGE PIPE MATERIALS**

- A. Plastic Pipe: ASTM D3034, Type PSM, Poly Vinyl Chloride (PVC) material; inside nominal diameter of 4 inches, bell and spigot style solvent sealed joint end.
- B. Cast in Place Concrete: Greenbook Section 201-1.

**2.02 PIPE ACCESSORIES**

- A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.
- B. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Storm Sewer Service " in large letters. Coordinate with Section 312316.13.

**2.03 BEDDING AND COVER MATERIALS**

- A. Bedding: As specified in Construction Drawings.
- B. Cover: As specified in Construction Drawings.

**2.04 CLEANOUTS**

- A. Cleanout: As specified in Construction Drawings.

**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.

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### 3.02 TRENCHING

- A. See Construction Drawings 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.

### 3.03 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 continuous trace wire 6 inches above top of pipe; coordinate with Section 312316.13.

### 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.
  - 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 014000 - 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 306-7.8.
  - 2. Infiltration Test: Test in accordance with Greenbook Section 306-7.8.
  - 3. Deflection Test: Test in accordance with Greenbook Section 306-7.8.

### 3.06 PROTECTION

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- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

**END OF SECTION**