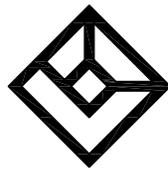


# City Clubhouse Project

636 Seneca St - Buffalo, NY 14210  
Developer -Larkin Development Group

9/21/2022



**SCHNEIDER**  
ARCHITECTURAL SERVICES

443 Delaware Ave. Buffalo, New York 14202

P: 716.923.7000

F: 716.882.4293

[schneiderdesign.com](http://schneiderdesign.com)

Division	Section Title	Pages
----------	---------------	-------

SPECIFICATIONS GROUP

*General Requirements Subgroup*

**DIVISION 01 - GENERAL REQUIREMENTS**

012500	SUBSTITUTION PROCEDURES	4
012900	PAYMENT PROCEDURES	3
013300	SUBMITTAL PROCEDURES	8
014000	QUALITY REQUIREMENTS	6
014200	REFERENCES	6
015000	TEMPORARY FACILITIES AND CONTROLS	6
016000	PRODUCT REQUIREMENTS	5
017300	EXECUTION	10
017700	CLOSEOUT PROCEDURES	5
017823	OPERATION AND MAINTENANCE DATA	7
017839	PROJECT RECORD DOCUMENTS	4
017900	DEMONSTRATION AND TRAINING	3

*Facility Construction Subgroup*

**DIVISION 02 - EXISTING CONDITIONS**

024119	SELECTIVE DEMOLITION	4
--------	----------------------	---

**DIVISION 03 CONCRETE**

033000	CAST IN PLACE CONCRETE	24
--------	------------------------	----

**DIVISION 04 - MASONRY**

040110	MASONRY CLEANING	4
042200	CLAY UNIT MASONRY	9
042516	THIN BRICK PANEL SYSTEM	13
047200	CAST STONE MASONRY	4

**DIVISION 05 - METALS**

055213	PIPE AND TUBE RAILINGS	6
--------	------------------------	---

**DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES**

061000	ROUGH CARPENTRY	6
061753	SHOP FABRICATED WOOD TRUSSES	5
062023	INTERIOR FINISH CARPENTRY	6
066500	PLASTIC SIMULATED WOOD EXTERIOR TRIM	8

**DIVISION 07 - THERMAL AND MOISTURE PROTECTION**

070150.19	PREPARATION FOR REROOFING	4
071000	FOUNDATION DAMPPROFFING & WATERPROFFING	4
072100	THERMAL INSULATION	4
072119	FOAMED-IN-PLACE INSULATION	2
073113	ASPHALT SHINGLES	6
074113.16	STANDING-SEAM METAL ROOF PANELS	6
075323	ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING	10
078413	PENETRATION FIRESTOPPING	4

078443	JOINT FIRESTOPPING	3
079200	JOINT SEALANTS	7
079219	ACOUSTICAL JOINT SEALANTS	2

**DIVISION 08 - OPENINGS**

081433	STILE AND RAIL WOOD DOORS	6
081613	FIBERGLASS ENTRY DOORS	8
085200	WOOD WINDOWS	4
086200	UNIT SKYLIGHTS	7
087100	DOOR HARDWARE	8
088300	MIRRORS	4

**DIVISION 09 - FINISHES**

092900	GYPSUM BOARD	5
096000.1	SOUND CONTROL UNDERLAYMENT	5
093013	CERAMIC TILING	8
096400	WOOD FLOORING	3
096513	RESILIENT BASE AND ACCESSORIES	4
096813	TILE CARPETING	4
099000	PAINTING	14

**DIVISION 10 - SPECIALTIES**

101423.16	ROOM-IDENTIFICATION PANEL SIGNAGE	4
102800	TOILET, BATH, AND LAUNDRY ACCESSORIES	6
102819	TUB AND SHOWER ENCLOSURES	3
104413	FIRE PROTECTION CABINETS	3

**DIVISION 11 - EQUIPMENT**

111200	PARKING CONTROL EQUIPMENT	5
--------	---------------------------	---

**DIVISION 12 - FURNISHING**

123530	RESIDENTIAL CASEWORK	3
--------	----------------------	---

123661.19	QUARTZ AGGLOMERATE COUNTERTOPS	2
-----------	--------------------------------	---

***Facility Services Subgroup***

**DIVISION 21 - FIRE SUPPRESSION**

211313	WET-PIPE SPRINKLER SYSTEMS	15
--------	----------------------------	----

**DIVISION 22 - PLUMBING**

220500	COMMON WORK RESULTS FOR PLUMBING	9
--------	----------------------------------	---

220553	IDENTIFICATION FOR PLUMBING PIPING	7
--------	------------------------------------	---

220719	PLUMBING PIPING INSULATION	9
--------	----------------------------	---

221116	DOMESTIC WATER PIPING	5
--------	-----------------------	---

221123	FACILITY NATURAL GAS PIPING	8
--------	-----------------------------	---

221316	SANITARY WASTE AND VENT PIPING	6
--------	--------------------------------	---

221413	FACILITY STORM DRAINAGE PIPING	8
--------	--------------------------------	---

224100	PLUMBING FIXTURES	9
--------	-------------------	---

**DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)**

230500	COMMON WORK RESULTS FOR HVAC	11
--------	------------------------------	----

232116	HYDRONIC PIPING SPECIALTIES	6
--------	-----------------------------	---

233100	METAL DUCTS	8
--------	-------------	---

233700	DIFFUSERS, REGISTERS, AND GRILLES	3
--------	-----------------------------------	---

**DIVISION 26 - ELECTRICAL**

260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES	5
260523	CONTROL-VOLTAGE ELECTRICAL POWER CABLES	4
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS	9
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS	7
260533	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS	12
260543	UNDERGROUND DUCTS & RACEWAYS FOR ELECTRICAL SYSTEMS	13
260544	SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS & CABLING	4
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS	8
260923	LIGHTING CONTROL DEVICES	8
262416	PANELBOARDS	11
262715	METER CENTERS AND METER STACKS	5
262726	WIRING DEVICES	10
262813	FUSES	4
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS	8
265100	INTERIOR LIGHTING	15
265600	EXTERIOR LIGHTING	10

**DIVISION 28 - ELECTRONIC SAFTEY AND SECURITY**

283112	FIRE ALARM SYSTEMS	45
--------	--------------------	----



SECTION 012500 -  
SUBSTITUTION  
PROCEDURES

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
  - 1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
  - 2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use form acceptable to Architect.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
    - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific

SECTION 012500 -  
SUBSTITUTION  
PROCEDURES

- features and requirements indicated. Indicate deviations, if any, from the Work specified.
- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. Certificates and qualification data, where applicable or requested.
  - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
  - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
  - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES .
  - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Sum.
  - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
  - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

SECTION 012500 -  
SUBSTITUTION  
PROCEDURES

1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - b. Substitution request is fully documented and properly submitted.
    - c. Requested substitution will not adversely affect Contractor's construction schedule.
    - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - e. Requested substitution is compatible with other portions of the Work.
    - f. Requested substitution has been coordinated with other portions of the Work.
    - g. Requested substitution provides specified warranty.
    - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work . Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
    - b. Requested substitution does not require extensive revisions to the Contract Documents.
    - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - d. Substitution request is fully documented and properly submitted.
    - e. Requested substitution will not adversely affect Contractor's construction schedule.
    - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - g. Requested substitution is compatible with other portions of the Work.
    - h. Requested substitution has been coordinated with other portions of the Work.
    - i. Requested substitution provides specified warranty.
    - j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

SECTION 012500 -  
SUBSTITUTION  
PROCEDURES

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012900 - PAYMENT  
PROCEDURES

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
  2. Submit the schedule of values to Architect through Construction Manager at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
1. Arrange schedule of values consistent with format of AIA Document G703 .
  2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
  3. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    - a. Differentiate between items stored on-site and items stored off-site.
  4. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
  5. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
  6. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.

1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and Construction Manager and paid for by Owner.

SECTION 012900 - PAYMENT  
PROCEDURES

- B. Payment Application Times: Submit Application for Payment to Architect by the xx of the month. The period covered by each Application for Payment is one month, ending on the last day of the month .
1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Construction Manager will return incomplete applications without action.
1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit one signed and notarized original copies of each Application for Payment to Construction Manager by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment .
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  2. When an application shows completion of an item, submit conditional final or full waivers.
  3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
  5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of values.
  3. Contractor's construction schedule (preliminary if not final).
  4. Products list (preliminary if not final).

SECTION 012900 - PAYMENT  
PROCEDURES

5. Sustainable design action plans, including preliminary project materials cost data.
  6. Schedule of unit prices.
  7. Submittal schedule (preliminary if not final).
  8. List of Contractor's staff assignments.
  9. List of Contractor's principal consultants.
  10. Copies of building permits.
  11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  12. Initial progress report.
  13. Report of preconstruction conference.
  14. Certificates of insurance and insurance policies.
  15. Performance and payment bonds.
  16. Data needed to acquire Owner's insurance.
- H. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  3. Updated final statement, accounting for final changes to the Contract Sum.
  4. AIA Document G706.
  5. AIA Document G706A.
  6. AIA Document G707.
  7. Evidence that claims have been settled.
  8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
  9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013300 -  
SUBMITTAL PROCEDURES

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's and Construction Manager's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
8. Category and type of submittal.

SECTION 013300 -  
SUBMITTAL PROCEDURES

9. Submittal purpose and description.
  10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
  11. Drawing number and detail references, as appropriate.
  12. Indication of full or partial submittal.
  13. Location(s) where product is to be installed, as appropriate.
  14. Other necessary identification.
  15. Remarks.
  16. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Paper Submittals:
1. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
  2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect and Construction Manager.
  3. Action Submittals: Submit 1 paper copies of each submittal unless otherwise indicated. Architect , through Construction Manager, will return 1 copies.
  4. Informational Submittals: Submit 1 Electronic copies of each submittal unless otherwise indicated. Architect and Construction Manager will not return copies.
  5. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using AIA Document G810 transmittal form.
- E. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
- F. Submittals for Utilizing Web-Based Project Management Software: Prepare submittals as PDF files, or other format indicated by Project management software.
- 1.5 SUBMITTAL PROCEDURES
- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

SECTION 013300 -  
SUBMITTAL PROCEDURES

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.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's Construction Manager's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's and Construction Manager's action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams that show factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.

SECTION 013300 -  
SUBMITTAL PROCEDURES

- d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    - a. Project name and submittal number.
    - b. Generic description of Sample.
    - c. Product name and name of manufacturer.
    - d. Sample source.
    - e. Number and title of applicable Specification Section.
    - f. Specification paragraph number and generic name of each item.
  3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
  4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
  5. Paper Transmittal: Include paper transmittal including complete submittal information indicated.
  6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from

SECTION 013300 -  
SUBMITTAL PROCEDURES

- manufacturer's product line. Architect , through Construction Manager, will return submittal with options selected.
8. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
- a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
- 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
  - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
  2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
  3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
  4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
  5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
  6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding

SECTION 013300 -  
SUBMITTAL PROCEDURES

Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - a. Name of evaluation organization.
  - b. Date of evaluation.
  - c. Time period when report is in effect.
  - d. Product and manufacturers' names.
  - e. Description of product.
  - f. Test procedures and results.
  - g. Limitations of use.

1.7 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

SECTION 013300 -  
SUBMITTAL PROCEDURES

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Construction Manager.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp . Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
  1. Architect and Construction Manager will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S AND CONSTRUCTION MANAGER'S REVIEW

- A. Action Submittals: Architect and Construction Manager will review each submittal, indicate corrections or revisions required , and return it.
  1. PDF Submittals: Architect and Construction Manager will indicate, via markup on each submittal, the appropriate action
    - a. .
  2. Paper Submittals: Architect and Construction Manager will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action
    - a. .
  3. Submittals by Web-Based Project Management Software: Architect and Construction Manager will indicate, on Project management software website, the appropriate action.
    - a. Actions taken by indication on Project management software website have the following meanings:
      - 1) .
- B. Informational Submittals: Architect and Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect and Construction Manager will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Construction Manager.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect and Construction Manager will return without review submittals received from sources other than Contractor.

SECTION 013300 -  
SUBMITTAL PROCEDURES

- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 014000 - QUALITY  
REQUIREMENTS

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
  - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

SECTION 014000 - QUALITY  
REQUIREMENTS

1. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements , consisting of multiple products, assemblies, and subassemblies, with cutaways enabling inspection of concealed portions of the Work.
    - a. Include each system, assembly, component, and part of the exterior wall to be constructed for the Project. Colors of components shall be those selected by the Architect for use in the Project.
  
  - E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
  
  - F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
  
  - G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
  
  - H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall have the same meaning as testing agency.
  
  - I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
  
  - J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.
- 1.3 CONFLICTING REQUIREMENTS

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

SECTION 014000 - QUALITY  
REQUIREMENTS

1.4 ACTION SUBMITTALS

1.5 INFORMATIONAL SUBMITTALS

1.6 REPORTS AND DOCUMENTS

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

SECTION 014000 - QUALITY  
REQUIREMENTS

1.7 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- D. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E329 ; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1.8 QUALITY CONTROL

- A. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- B. Testing Agency Responsibilities: Cooperate with Architect , Commissioning Authority , Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
  - 1. Notify Architect , Commissioning Authority, , Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  - 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
  - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  - 6. Do not perform duties of Contractor.

SECTION 014000 - QUALITY  
REQUIREMENTS

1.9 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner , as indicated in the Statement of Special Inspections attached to this Section, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
  2. Notifying Architect , Commissioning Authority, , Construction Manager, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority , through Construction Manager, with copy to Contractor and to authorities having jurisdiction.
  4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
  5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
  6. Retesting and reinspecting corrected Work.
  7. .

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

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

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

SECTION 014000 - QUALITY  
REQUIREMENTS

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

END OF SECTION 014000

SECTION 014200 -  
REFERENCES

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

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

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

SECTION 014200 -  
REFERENCES

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Abbreviations and acronyms not included in this list shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States." The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. [AABC - Associated Air Balance Council; www.aabc.com.](http://www.aabc.com)
2. [AAMA - American Architectural Manufacturers Association; www.aamanet.org.](http://www.aamanet.org)
3. [ABMA - American Bearing Manufacturers Association; www.americanbearings.org.](http://www.americanbearings.org)
4. [ACI - American Concrete Institute; \(Formerly: ACI International\); www.concrete.org.](http://www.concrete.org)
5. [AEIC - Association of Edison Illuminating Companies, Inc. \(The\); www.aeic.org.](http://www.aeic.org)
6. [AF&PA - American Forest & Paper Association; www.afandpa.org.](http://www.afandpa.org)
7. [AGA - American Gas Association; www.aga.org.](http://www.aga.org)
8. [AHAM - Association of Home Appliance Manufacturers; www.aham.org.](http://www.aham.org)
9. [AHRI - Air-Conditioning, Heating, and Refrigeration Institute \(The\); www.ahrinet.org.](http://www.ahrinet.org)
10. [AI - Asphalt Institute; www.asphaltinstitute.org.](http://www.asphaltinstitute.org)
11. [AIA - American Institute of Architects \(The\); www.aia.org.](http://www.aia.org)
12. [AISC - American Institute of Steel Construction; www.aisc.org.](http://www.aisc.org)
13. [AISI - American Iron and Steel Institute; www.steel.org.](http://www.steel.org)
14. [AITC - American Institute of Timber Construction; www.aitc-glulam.org.](http://www.aitc-glulam.org)
15. [AMCA - Air Movement and Control Association International, Inc.; www.amca.org.](http://www.amca.org)
16. [ANSI - American National Standards Institute; www.ansi.org.](http://www.ansi.org)
17. [APA - APA - The Engineered Wood Association; www.apawood.org.](http://www.apawood.org)
18. [APA - Architectural Precast Association; www.archprecast.org.](http://www.archprecast.org)
19. [API - American Petroleum Institute; www.api.org.](http://www.api.org)
20. [ARI - Air-Conditioning & Refrigeration Institute; \(See AHRI\).](#)
21. [ARI - American Refrigeration Institute; \(See AHRI\).](#)
22. [ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.](http://www.asphaltroofing.org)
23. [ASCE - American Society of Civil Engineers; www.asce.org.](http://www.asce.org)
24. [ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; \(See ASCE\).](#)
25. [ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.](http://www.ashrae.org)
26. [ASME - ASME International; \(American Society of Mechanical Engineers\); www.asme.org.](http://www.asme.org)
27. [ASSE - American Society of Safety Engineers \(The\); www.asse.org.](http://www.asse.org)
28. [ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.](http://www.asse-plumbing.org)
29. [ASTM - ASTM International; www.astm.org.](http://www.astm.org)
30. [AWI - Architectural Woodwork Institute; www.awinet.org.](http://www.awinet.org)
31. [AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.](http://www.awmac.com)
32. [AWPA - American Wood Protection Association; www.awpa.com.](http://www.awpa.com)
33. [AWS - American Welding Society; www.aws.org.](http://www.aws.org)
34. [AWWA - American Water Works Association; www.awwa.org.](http://www.awwa.org)
35. [BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.](http://www.buildershardware.com)
36. [BIA - Brick Industry Association \(The\); www.gobrick.com.](http://www.gobrick.com)
37. [BICSI - BICSI, Inc.; www.bicsi.org.](http://www.bicsi.org)

SECTION 014200 -  
REFERENCES

38. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); [www.bifma.org](http://www.bifma.org).
39. CDA - Copper Development Association; [www.copper.org](http://www.copper.org).
40. CE - Conformance Européenne; <http://ec.europa.eu/growth/single-market/ce-marking/>.
41. CEA - Consumer Electronics Association; [www.cea.org](http://www.cea.org).
42. CFFA - Chemical Fabrics and Film Association, Inc.; [www.chemicalfabricsandfilm.com](http://www.chemicalfabricsandfilm.com).
43. CFSEI - Cold-Formed Steel Engineers Institute; [www.cfsei.org](http://www.cfsei.org).
44. CGA - Compressed Gas Association; [www.cganet.com](http://www.cganet.com).
45. CIMA - Cellulose Insulation Manufacturers Association; [www.cellulose.org](http://www.cellulose.org).
46. CISCA - Ceilings & Interior Systems Construction Association; [www.cisca.org](http://www.cisca.org).
47. CPA - Composite Panel Association; [www.pbmdf.com](http://www.pbmdf.com).
48. CRI - Carpet and Rug Institute (The); [www.carpet-rug.org](http://www.carpet-rug.org).
49. CRSI - Concrete Reinforcing Steel Institute; [www.crsi.org](http://www.crsi.org).
50. CSA - CSA Group; [www.csagroup.com](http://www.csagroup.com).
51. CSA - CSA International; (Formerly: IAS - International Approval Services); [www.csa-international.org](http://www.csa-international.org).
52. CSI - Construction Specifications Institute (The); [www.csinet.org](http://www.csinet.org).
53. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); [www.cti.org](http://www.cti.org).
54. CWC - Composite Wood Council; (See CPA).
55. DASMA - Door and Access Systems Manufacturers Association; [www.dasma.com](http://www.dasma.com).
56. DHI - Door and Hardware Institute; [www.dhi.org](http://www.dhi.org).
57. ECA - Electronic Components Association; (See ECIA).
58. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
59. ECIA - Electronic Components Industry Association; [www.eciaonline.org](http://www.eciaonline.org).
60. EIA - Electronic Industries Alliance; (See TIA).
61. EIMA - EIFS Industry Members Association; [www.eima.com](http://www.eima.com).
62. EJMA - Expansion Joint Manufacturers Association, Inc.; [www.ejma.org](http://www.ejma.org).
63. ESD - ESD Association; (Electrostatic Discharge Association); [www.esda.org](http://www.esda.org).
64. ESTA - Entertainment Services and Technology Association; (See PLASA).
65. ETL - Intertek (See Intertek); [www.intertek.com](http://www.intertek.com).
66. EVO - Efficiency Valuation Organization; [www.evo-world.org](http://www.evo-world.org).
67. FCI - Fluid Controls Institute; [www.fluidcontrolsinstitute.org](http://www.fluidcontrolsinstitute.org).
68. FM Approvals - FM Approvals LLC; [www.fmglobal.com](http://www.fmglobal.com).
69. FM Global - FM Global; (Formerly: FMG - FM Global); [www.fmglobal.com](http://www.fmglobal.com).
70. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; [www.floridarooft.com](http://www.floridarooft.com).
71. FSA - Fluid Sealing Association; [www.fluidsealing.com](http://www.fluidsealing.com).
72. FSC - Forest Stewardship Council U.S.; [www.fscus.org](http://www.fscus.org).
73. GA - Gypsum Association; [www.gypsum.org](http://www.gypsum.org).
74. GANA - Glass Association of North America; [www.glasswebsite.com](http://www.glasswebsite.com).
75. GS - Green Seal; [www.green Seal.org](http://www.green Seal.org).
76. HI - Hydraulic Institute; [www.pumps.org](http://www.pumps.org).
77. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
78. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
79. HPVA - Hardwood Plywood & Veneer Association; [www.hpva.org](http://www.hpva.org).
80. HPW - H. P. White Laboratory, Inc.; [www.hpwhite.com](http://www.hpwhite.com).
81. IAPSC - International Association of Professional Security Consultants; [www.iapsc.org](http://www.iapsc.org).
82. IAS - International Accreditation Service; [www.iasonline.org](http://www.iasonline.org).
83. IAS - International Approval Services; (See CSA).
84. ICBO - International Conference of Building Officials; (See ICC).
85. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).

SECTION 014200 -  
REFERENCES

86. [ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.](http://www.icea.net)
87. [ICPA - International Cast Polymer Alliance; www.icpa-hq.org.](http://www.icpa-hq.org)
88. [ICRI - International Concrete Repair Institute, Inc.; www.icri.org.](http://www.icri.org)
89. [IEC - International Electrotechnical Commission; www.iec.ch.](http://www.iec.ch)
90. [IEEE - Institute of Electrical and Electronics Engineers, Inc. \(The\); www.ieee.org.](http://www.ieee.org)
91. [IES - Illuminating Engineering Society; \(Formerly: Illuminating Engineering Society of North America\); www.ies.org.](http://www.ies.org)
92. IESNA - Illuminating Engineering Society of North America; (See IES).
93. [IEST - Institute of Environmental Sciences and Technology; www.iest.org.](http://www.iest.org)
94. [IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.](http://www.igmaonline.org)
95. [ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.](http://www.iliai.com)
96. [Intertek - Intertek Group; \(Formerly: ETL SEMCO; Intertek Testing Service NA\); www.intertek.com.](http://www.intertek.com)
97. [ISA - International Society of Automation \(The\); \(Formerly: Instrumentation, Systems, and Automation Society\); www.isa.org.](http://www.isa.org)
98. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
99. [ISFA - International Surface Fabricators Association; \(Formerly: International Solid Surface Fabricators Association\); www.isfanow.org.](http://www.isfanow.org)
100. [ISO - International Organization for Standardization; www.iso.org.](http://www.iso.org)
101. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
102. [ITU - International Telecommunication Union; www.itu.int/home.](http://www.itu.int/home)
103. [KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.](http://www.kcma.org)
104. LMA - Laminating Materials Association; (See CPA).
105. [MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.](http://www.maplefloor.org)
106. [MHIA - Material Handling Industry of America; www.mhia.org.](http://www.mhia.org)
107. [MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.](http://www.wmmpa.com)
108. [MPI - Master Painters Institute; www.paintinfo.com.](http://www.paintinfo.com)
109. [MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.](http://www.mss-hq.org)
110. [NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.](http://www.naamm.org)
111. [NACE - NACE International; \(National Association of Corrosion Engineers International\); www.nace.org.](http://www.nace.org)
112. [NADCA - National Air Duct Cleaners Association; www.nadca.com.](http://www.nadca.com)
113. [NAIMA - North American Insulation Manufacturers Association; www.naima.org.](http://www.naima.org)
114. [NBI - New Buildings Institute; www.newbuildings.org.](http://www.newbuildings.org)
115. [NCMA - National Concrete Masonry Association; www.ncma.org.](http://www.ncma.org)
116. [NEBB - National Environmental Balancing Bureau; www.nebb.org.](http://www.nebb.org)
117. [NECA - National Electrical Contractors Association; www.necanet.org.](http://www.necanet.org)
118. [NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.](http://www.nelma.org)
119. [NEMA - National Electrical Manufacturers Association; www.nema.org.](http://www.nema.org)
120. [NETA - InterNational Electrical Testing Association; www.netaworld.org.](http://www.netaworld.org)
121. [NFPA - National Fire Protection Association; www.nfpa.org.](http://www.nfpa.org)
122. NFPA - NFPA International; (See NFPA).
123. [NFRC - National Fenestration Rating Council; www.nfrc.org.](http://www.nfrc.org)
124. [NHLA - National Hardwood Lumber Association; www.nhla.com.](http://www.nhla.com)
125. [NLGA - National Lumber Grades Authority; www.nlga.org.](http://www.nlga.org)
126. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
127. [NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.](http://www.nomma.org)
128. [NRCA - National Roofing Contractors Association; www.nrca.net.](http://www.nrca.net)
129. [NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.](http://www.nrmca.org)

SECTION 014200 -  
REFERENCES

130. NSF - NSF International; [www.nsf.org](http://www.nsf.org).
131. NSPE - National Society of Professional Engineers; [www.nspe.org](http://www.nspe.org).
132. NWFA - National Wood Flooring Association; [www.nwfa.org](http://www.nwfa.org).
133. PCI - Precast/Prestressed Concrete Institute; [www.pci.org](http://www.pci.org).
134. PDI - Plumbing & Drainage Institute; [www.pdionline.org](http://www.pdionline.org).
135. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); [www.plasa.org](http://www.plasa.org).
136. RCSC - Research Council on Structural Connections; [www.boltcouncil.org](http://www.boltcouncil.org).
137. RFCI - Resilient Floor Covering Institute; [www.rfci.com](http://www.rfci.com).
138. SAE - SAE International; [www.sae.org](http://www.sae.org).
139. SCTE - Society of Cable Telecommunications Engineers; [www.scte.org](http://www.scte.org).
140. SDI - Steel Door Institute; [www.steeldoor.org](http://www.steeldoor.org).
141. SEFA - Scientific Equipment and Furniture Association (The); [www.sefalabs.com](http://www.sefalabs.com).
142. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
143. SIA - Security Industry Association; [www.siaonline.org](http://www.siaonline.org).
144. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; [www.smacna.org](http://www.smacna.org).
145. SPFA - Spray Polyurethane Foam Alliance; [www.sprayfoam.org](http://www.sprayfoam.org).
146. SPIB - Southern Pine Inspection Bureau; [www.spib.org](http://www.spib.org).
147. SRCC - Solar Rating & Certification Corporation; [www.solar-rating.org](http://www.solar-rating.org).
148. SSPC - SSPC: The Society for Protective Coatings; [www.sspc.org](http://www.sspc.org).
149. TCA - Tilt-Up Concrete Association; [www.tilt-up.org](http://www.tilt-up.org).
150. TCNA - Tile Council of North America, Inc.; [www.tileusa.com](http://www.tileusa.com).
151. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); [www.tiaonline.org](http://www.tiaonline.org).
152. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
153. TMS - The Masonry Society; [www.masonrysociety.org](http://www.masonrysociety.org).
154. TPI - Truss Plate Institute; [www.tpinst.org](http://www.tpinst.org).
155. UL - Underwriters Laboratories Inc.; [www.ul.com](http://www.ul.com).
156. UNI - Uni-Bell PVC Pipe Association; [www.uni-bell.org](http://www.uni-bell.org).
157. USGBC - U.S. Green Building Council; [www.usgbc.org](http://www.usgbc.org).
158. WA - Wallcoverings Association; [www.wallcoverings.org](http://www.wallcoverings.org).
159. WASTEC - Waste Equipment Technology Association; [www.wastec.org](http://www.wastec.org).
160. WCMA - Window Covering Manufacturers Association; [www.wcmanet.org](http://www.wcmanet.org).
161. WDMA - Window & Door Manufacturers Association; [www.wdma.com](http://www.wdma.com).
162. WI - Woodwork Institute; [www.wicnet.org](http://www.wicnet.org).

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

1. IAPMO - International Association of Plumbing and Mechanical Officials; [www.iapmo.org](http://www.iapmo.org).
2. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
3. ICC-ES - ICC Evaluation Service, LLC; [www.icc-es.org](http://www.icc-es.org).

C. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and

SECTION 014200 -  
REFERENCES

regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. USAB - United States Access Board; [www.access-board.gov](http://www.access-board.gov).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 -  
TEMPORARY FACILITIES  
AND CONTROLS

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.2 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

1.3 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

SECTION 015000 -  
TEMPORARY FACILITIES  
AND CONTROLS

3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures."

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
  1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- C. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

SECTION 015000 -  
TEMPORARY FACILITIES  
AND CONTROLS

3.4 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E136. Comply with NFPA 241.
  2. Utilize designated area within existing building for temporary field offices.
  3. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- D. Storage and Staging: Use designated areas of Project site for storage and staging needs.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
  2. Remove snow and ice as required to minimize accumulations.
- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
  2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
    - a. Provide temporary, directional signs for construction personnel and visitors.
  3. Maintain and touch up signs so they are legible at all times.
- G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

SECTION 015000 -  
TEMPORARY FACILITIES  
AND CONTROLS

- J. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
  - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.
- K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
  - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
  - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
  - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
  - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
  - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- C. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

3.6 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

SECTION 015000 -  
TEMPORARY FACILITIES  
AND CONTROLS

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

### 3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

SECTION 015000 -  
TEMPORARY FACILITIES  
AND CONTROLS

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT  
REQUIREMENTS

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
  - 1. Section 012500 "Substitution Procedures" for requests for substitutions.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
  - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
  - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

## SECTION 016000 - PRODUCT REQUIREMENTS

- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
  - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
  - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."
- F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

### 1.3 QUALITY ASSURANCE

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

### 1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

### 1.5 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  - 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
  - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

SECTION 016000 - PRODUCT  
REQUIREMENTS

- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
  3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

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

SECTION 016000 - PRODUCT  
REQUIREMENTS

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
    - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
    - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
  5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
    - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
  6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
    - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
    - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
  7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
    - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
- 2.2 COMPARABLE PRODUCTS
- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following

SECTION 016000 - PRODUCT  
REQUIREMENTS

conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
  3. Evidence that proposed product provides specified warranty.
  4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
  5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
  2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
- D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 -  
EXECUTION

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. Installation of the Work.
  - 4. Cutting and patching.
  - 5. Coordination of Owner's portion of the Work.
  - 6. Coordination of Owner-installed products.
  - 7. Progress cleaning.
  - 8. Starting and adjusting.
  - 9. Protection of installed construction.
  
- B. Related Requirements:
  - 1. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.2 DEFINITIONS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Certificates: Submit certificate signed by , certifying that location and elevation of improvements comply with requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Final Property Survey: Submit 3 copies showing the Work performed and record survey data.

SECTION 017300 -  
EXECUTION

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
  - 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
  - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
  - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
  - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
  - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
  - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

SECTION 017300 -  
EXECUTION

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

SECTION 017300 -  
EXECUTION

3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

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

SECTION 017300 -  
EXECUTION

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
  - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
  - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
  - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb, and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
  - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

SECTION 017300 -  
EXECUTION

- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
  - 1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.

SECTION 017300 -  
EXECUTION

- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
  - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of

SECTION 017300 -  
EXECUTION

wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

- A. Site Access: Provide access to Project site for Owner's construction personnel and Owner's separate contractors.
1. Provide temporary facilities required for Owner-furnished, Contractor-installed products.
  2. Refer to Section 011000 "Summary" for other requirements for Owner-furnished, Contractor-installed products
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel and Owner's separate contractors.
1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.

3.8 PROGRESS CLEANING

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

SECTION 017300 -  
EXECUTION

2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

SECTION 017300 -  
EXECUTION

3.10 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017700 -  
CLOSEOUT PROCEDURES

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.
  
- B. Related Requirements:
  - 1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
  - 2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 3. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.4 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

SECTION 017700 -  
CLOSEOUT PROCEDURES

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
  3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect . Label with manufacturer's name and model number.
  5. Submit testing, adjusting, and balancing records.
  6. Submit sustainable design submittals not previously submitted.
  7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
  6. Advise Owner of changeover in utility services.
  7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  9. Complete final cleaning requirements.
  10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1.5 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

SECTION 017700 -  
CLOSEOUT PROCEDURES

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
  2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1.6 LIST OF INCOMPLETE ITEMS

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

1.7 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

SECTION 017700 -  
CLOSEOUT PROCEDURES

1. Submit on digital media acceptable to Architect .
- D. Warranties in Paper Form:
1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
- E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
    - b. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - c. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - d. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
    - e. Vacuum and mop concrete.
    - f. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.

SECTION 017700 -  
CLOSEOUT PROCEDURES

- g. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
- h. Remove labels that are not permanent.
- i. Wipe surfaces of mechanical and electrical equipment , elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- j. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- k. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- l. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
  - 1) Clean HVAC system in compliance with NADCA ACR.
- m. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
- n. Clean strainers.
- o. Leave Project clean and ready for occupancy.

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 -  
OPERATION AND  
MAINTENANCE DATA

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
1. Operation and maintenance documentation directory manuals.
  2. Emergency manuals.
  3. Systems and equipment operation manuals.
  4. Systems and equipment maintenance manuals.
  5. Product maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
  2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
1. Submit on digital media acceptable to Architect . Enable reviewer comments on draft submittals.
  2. Submit 2 paper copies. Architect , through Construction Manager, will return two copies.
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- D. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

SECTION 017823 -  
OPERATION AND  
MAINTENANCE DATA

1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
  2. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.4 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
  2. Table of contents.
  3. Manual contents.
- B. Title Page: Include the following information:
1. Subject matter included in manual.
  2. Name and address of Project.
  3. Name and address of Owner.
  4. Date of submittal.
  5. Name and contact information for Contractor.
  6. Name and contact information for Construction Manager.
  7. Name and contact information for Architect.
  8. Name and contact information for Commissioning Authority.

SECTION 017823 -  
OPERATION AND  
MAINTENANCE DATA

9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.5 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
  2. Emergency instructions.
  3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
  2. Gas leak.
  3. Water leak.
  4. Power failure.
  5. Water outage.
  6. System, subsystem, or equipment failure.
  7. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
  2. Shutdown instructions for each type of emergency.

SECTION 017823 -  
OPERATION AND  
MAINTENANCE DATA

3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.6 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
  1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  2. Performance and design criteria if Contractor has delegated design responsibility.
  3. Operating standards.
  4. Operating procedures.
  5. Operating logs.
  6. Wiring diagrams.
  7. Control diagrams.
  8. Piped system diagrams.
  9. Precautions against improper use.
  10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
  1. Product name and model number. Use designations for products indicated on Contract Documents.
  2. Manufacturer's name.
  3. Equipment identification with serial number of each component.
  4. Equipment function.
  5. Operating characteristics.
  6. Limiting conditions.
  7. Performance curves.
  8. Engineering data and tests.
  9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
  1. Startup procedures.
  2. Equipment or system break-in procedures.
  3. Routine and normal operating instructions.
  4. Regulation and control procedures.
  5. Instructions on stopping.
  6. Normal shutdown instructions.
  7. Seasonal and weekend operating instructions.
  8. Required sequences for electric or electronic systems.

SECTION 017823 -  
OPERATION AND  
MAINTENANCE DATA

9. Special operating instructions and procedures.

- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.7 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds, as described below.
- C. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
  - 1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
    - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
  - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - 3. Identification and nomenclature of parts and components.
  - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
  - 1. Test and inspection instructions.
  - 2. Troubleshooting guide.
  - 3. Precautions against improper maintenance.
  - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - 5. Aligning, adjusting, and checking instructions.
  - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

SECTION 017823 -  
OPERATION AND  
MAINTENANCE DATA

- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.
- H. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1.8 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material and chemical composition.
  - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures.
  - 2. Types of cleaning agents to be used and methods of cleaning.
  - 3. List of cleaning agents and methods of cleaning detrimental to product.
  - 4. Schedule for routine cleaning and maintenance.
  - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

SECTION 017823 -  
OPERATION AND  
MAINTENANCE DATA

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT  
RECORD DOCUMENTS

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record Product Data.
- B. Related Requirements:
  - 1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit one set(s) of marked-up record prints.
  - 2. Number of Copies: Submit copies of Record Drawings as follows:
    - a. Initial Submittal:
      - 1) Submit one paper-copy set(s) of marked-up record prints.
      - 2) Submit PDF electronic files of scanned record prints and one set(s) of file prints.
      - 3) Submit Record Digital Data Files and one set(s) of plots.
      - 4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
    - b. Final Submittal:
      - 1) Submit 2 paper-copy set(s) of marked-up record prints.
      - 2) Submit PDF electronic files of scanned Record Prints and 2 set(s) of file prints.
      - 3) Print each drawing, whether or not changes and additional information were recorded.
    - c. Final Submittal:
      - 1) Submit one paper-copy set(s) of marked-up record prints.
      - 2) Submit Record Digital Data Files and 2 set(s) of Record Digital Data File plots.
      - 3) Plot each drawing file, whether or not changes and additional information were recorded.

SECTION 017839 - PROJECT  
RECORD DOCUMENTS

1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding photographic documentation.
  2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or Construction Work Change Directive.
    - k. Changes made following Architect's written orders.
    - l. Details not on the original Contract Drawings.
    - m. Field records for variable and concealed conditions.
    - n. Record information on the Work that is shown only schematically.
  3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
  2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  3. Refer instances of uncertainty to Architect through Construction Manager for resolution.
  4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

SECTION 017839 - PROJECT  
RECORD DOCUMENTS

- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
  - 1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  - 2. Format: Annotated PDF electronic file with comment function enabled.
  - 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  - 4. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect and Construction Manager.
    - e. Name of Contractor.

1.4 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  - 3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
- C. Format: Submit Record Product Data as annotated PDF electronic file paper copy .
  - 1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.5 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's and Construction Manager's reference during normal working hours.

SECTION 017839 - PROJECT  
RECORD DOCUMENTS

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 017900 -  
DEMONSTRATION AND  
TRAINING

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.

1.2 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

1.3 COORDINATION

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

1.4 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.

SECTION 017900 -  
DEMONSTRATION AND  
TRAINING

- d. Regulatory requirements.
  - e. Equipment function.
  - f. Operating characteristics.
  - g. Limiting conditions.
  - h. Performance curves.
2. Documentation: Review the following items in detail:
- a. Emergency manuals.
  - b. Systems and equipment operation manuals.
  - c. Systems and equipment maintenance manuals.
  - d. Product maintenance manuals.
  - e. Project Record Documents.
  - f. Identification systems.
  - g. Warranties and bonds.
  - h. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
- a. Instructions on meaning of warnings, trouble indications, and error messages.
  - b. Instructions on stopping.
  - c. Shutdown instructions for each type of emergency.
  - d. Operating instructions for conditions outside of normal operating limits.
  - e. Sequences for electric or electronic systems.
  - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
- a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Control sequences.
  - f. Safety procedures.
  - g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
  - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning.
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.

SECTION 017900 -  
DEMONSTRATION AND  
TRAINING

- g. Instruction on use of special tools.
- 8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

1.5 PREPARATION

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

1.6 INSTRUCTION

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

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017900

SECTION 024119 -  
SELECTIVE DEMOLITION

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.2 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.3 PREINSTALLATION MEETINGS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property , for environmental protection , for dust control and , for noise control. Indicate proposed locations and construction of barriers.

1.5 CLOSEOUT SUBMITTALS

- A. Inventory of items that have been removed and salvaged.

1.6 FIELD CONDITIONS

- A. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- B. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
1. Hazardous materials will be removed by Owner before start of the Work.
  2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- C. Storage or sale of removed items or materials on-site is not permitted.

SECTION 024119 -  
SELECTIVE DEMOLITION

- D. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.
- E. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Inventory and record the condition of items to be removed and salvaged.

3.2 PREPARATION

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Arrange to shut off utilities with utility companies.
  - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

SECTION 024119 -  
SELECTIVE DEMOLITION

- b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
- c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  - 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  - 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  - 4. Maintain fire watch during and for at least 1 hours after flame-cutting operations.
  - 5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  - 6. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items:
  - 1. Clean salvaged items.
  - 2. Protect items from damage during transport and storage.
- C. Removed and Reinstalled Items:

SECTION 024119 -  
SELECTIVE DEMOLITION

1. Clean and repair items to functional condition adequate for intended reuse.
  2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 CLEANING

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
1. Do not allow demolished materials to accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

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

### **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 cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
  - 1. Footings.
  - 2. Foundation walls.
  - 3. Slabs-on-grade.
  - 4. Suspended slabs.
  - 5. Concrete toppings.

#### **1.3 DEFINITIONS**

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
  - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. 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.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Cementitious materials.
  - 2. Admixtures.
  - 3. Form materials and form-release agents.
  - 4. Steel reinforcement and accessories.
  - 5. Waterstops.
  - 6. Curing compounds.
  - 7. Floor and slab treatments.
  - 8. Bonding agents.
  - 9. Adhesives.
  - 10. Joint-filler strips.
  - 11. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
  - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.

- B. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
  - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

## PART 2 - PRODUCTS

### 2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - 1. Metal or other approved panel materials.
  - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - a. High-density overlay, Class 1 or better.
    - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
    - c. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- E. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
  - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
  - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

## 2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Plain-Steel Wire: ASTM A 82, as drawn.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

## 2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel

wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

## 2.4 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 I/II. Supplement with the following:
  - a. Fly Ash: ASTM C 618, Class F.

B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a 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.

1. Maximum Coarse-Aggregate Size: As indicated in design mixes.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94 and potable.

## 2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing

chloride reactions with steel reinforcement in concrete and complying with ASTM C 494, Type C.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Euclid Chemical Company (The), an RPM company; EUCON CIA.
  - b. Grace Construction Products, W. R. Grace & Co.; DCI.
  - c. Sika Corporation; Sika CNI.

## 2.6 WATERSTOPS

- A. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BoMetals, Inc.
    - b. Greenstreak.
    - c. Vinylex Corp.
  2. Profile: Ribbed with center bulb.
  3. Dimensions: As applicable to location; nontapered.
- B. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Concrete Sealants Inc.; Conseal CS-231.
    - b. Greenstreak; Swellstop.
    - c. Henry Company, Sealants Division; Hydro-Flex.
    - d. JP Specialties, Inc.; Earth Shield Type 20.
- C. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Adeka Ultra Seal/OCM, Inc.; Adeka Ultra Seal.
    - b. Greenstreak; Hydrotite.
    - c. Vinylex Corp.; Swellseal.

## 2.7 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ChemMasters; Chemisil Plus.
    - b. ChemTec Int'l; ChemTec One.
    - c. Conspec by Dayton Superior; Intraseal.
    - d. Edoco by Dayton Superior; Titan Hard.
    - e. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
    - f. Meadows, W. R., Inc.; LIQUI-HARD.
    - g. Symons by Dayton Superior; Buff Hard.

## 2.8 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ChemMasters; SprayFilm.
    - b. Conspec by Dayton Superior; Aquafilm.
    - c. Edoco by Dayton Superior; BurkeFilm.
    - d. Euclid Chemical Company (The), an RPM company; Eucobar.
    - e. L&M Construction Chemicals, Inc.; E-CON.
    - f. Meadows, W. R., Inc.; EVAPRE.
    - g. Sika Corporation; SikaFilm.
    - h. Symons by Dayton Superior; Finishing Aid.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.

- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Construction Chemicals - Building Systems; Kure-N-Seal W.
    - b. ChemMasters; Safe-Cure Clear.
    - c. Conspec by Dayton Superior; High Seal.
    - d. Euclid Chemical Company (The), an RPM company; Diamond Clear VOX; Clearseal WB STD.
    - e. L&M Construction Chemicals, Inc.; Dress & Seal WB.
    - f. Meadows, W. R., Inc.; Vocomp-20.
    - g. Symons by Dayton Superior; Cure & Seal 18 Percent E.
- F. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Construction Chemicals - Building Systems; Kure-N-Seal 25 LV.
    - b. ChemMasters; Spray-Cure & Seal Plus.
    - c. Conspec by Dayton Superior; Sealcure 1315.
    - d. Edoco by Dayton Superior; Cureseal 1315.
    - e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear; LusterSeal 300.
    - f. L&M Construction Chemicals, Inc.; Lumiseal Plus.
    - g. Meadows, W. R., Inc.; CS-309/30.

## 2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

- D. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

## 2.10 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.

- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

## 2.11 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the 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 mixture designs based on laboratory trial mixtures.

- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
  2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
  4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

## 2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings and Non-Retaining Walls: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: SEE PROJECT NOTES
  2. Maximum Water-Cementitious Materials Ratio by Weight: 0.50.
  3. Minimum Cementitious Materials Content: 475 lb/cu. yd.
  4. Maximum Nominal Aggregate Size: 1 inch.
  5. Maximum Slump Limit: 3-1/2 inches, plus 1 inch.
  6. Air Content: 4 to 6 percent.
- B. Slabs-on-Grade (Interior): Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: SEE PROJECT NOTES
  2. Maximum Water-Cementitious Materials Ratio by Weight: 0.45.
  3. Minimum Cementitious Materials Content: 540 lb/cu. yd.
  4. Maximum Nominal Aggregate Size: 1 inch.
  5. Maximum Slump Limit: 3-1/2 inches, plus 1 inch.
- C. Foundation and Retaining Walls: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: SEE PROJECT NOTES
  2. Maximum Water-Cementitious Materials Ratio by Weight: 0.45.

3. Minimum Cementitious Materials Content: 590 lb./cu.yd.
4. Maximum Nominal Aggregate Size: 1-1/2 inches.
5. Maximum Slump Limit: 3-1/2 inches, plus 1 inch.
6. Air Content: 4 to 6 percent.

#### 2.13 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

#### 2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.
  1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

### PART 3 - EXECUTION

#### 3.1 FORMWORK

- A. 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.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
  1. Class A, 1/8 inch for smooth-formed finished surfaces.
  2. Class C, 1/2 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where 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. 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.
  - G. 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.
  - H. Chamfer exterior corners and edges of permanently exposed concrete.
  - I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
  - J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
  - K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
  - L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 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 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."
  2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
  3. Install dovetail anchor slots in concrete structures as indicated.

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, 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 24 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. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. 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.

### 3.4 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
  - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

### 3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  - 1. Do not cut or puncture underslab waterproofing. Repair damage and reseal underslab waterproofing before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. 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.

### 3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction 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. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
  - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth Insert depth of concrete thickness as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when

cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, 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 Section 07 9200 "Joint Sealants," are indicated.
  - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

### 3.7 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

### 3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items and underslab waterproofing is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
  - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

- 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. If a section cannot be placed continuously, provide construction joints as indicated. 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. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
  3. 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. 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.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  2. Maintain reinforcement in position on chairs during concrete placement.
  3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  4. Slope surfaces uniformly to drains where required.
  5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. 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 or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 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.

### 3.9 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
  1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
  2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
  3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. 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. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
  - 1. Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
  - 1. Apply float finish to surfaces to receive trowel finish or to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
  - 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
  - 3. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
  - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
  - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

### 3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the 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 at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

### 3.12 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 ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed 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.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 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 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 not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
  - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
  - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
  - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
  - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.13 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
  1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  2. 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.

### 3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  2. After concrete has cured at least 14 days, correct high areas by grinding.
  3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
  5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

### 3.15 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.
- B. Inspections:
1. Steel reinforcement placement.
  2. Steel reinforcement welding.
  3. Headed bolts and studs.
  4. Verification of use of required design mixture.
  5. 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., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

2. Slump: ASTM C 143; 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, for normal-weight concrete; 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; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compressive-Strength Tests: ASTM C 39; 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 one set of two specimens at 28 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.
6. 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.
7. 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.
8. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
9. 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.
10. 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 or by other methods as directed by Architect.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

- D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

### 3.16 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 040110 - MASONRY  
CLEANING

SECTION 040110 - MASONRY CLEANING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cleaning the following:
1. Unit masonry surfaces.
  2. Stone surfaces.

1.2 DEFINITIONS

- A. Low-Pressure Spray: 100 to 400 psi ; 4 to 6 gpm .

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

- A. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.
1. Cleaning: Clean an area approximately 25 sq. ft. for each type of masonry and surface condition.
    - a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not test cleaners and methods known to have deleterious effect.
    - b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.

PART 2 - PRODUCTS

2.1 PAINT REMOVERS

- A. Covered or Skin-Forming Alkaline Paint Remover: Manufacturer's standard covered or skin-forming, alkaline paste or gel formulation, for removing paint from masonry; containing no methylene chloride.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Building Restoration Products, Inc.
    - b. Diedrich Technologies, Inc.; a Hohmann & Barnard company.
    - c. Dumond Chemicals, Inc.

SECTION 040110 - MASONRY  
CLEANING

2.2 CLEANING MATERIALS

- A. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent, and 20 quarts of hot water for every 5 gal. of solution required.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent paint removers and chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.
  - 1. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.

3.2 CLEANING MASONRY, GENERAL

- A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 feet away by Architect.
- B. Proceed with cleaning in an orderly manner; work from top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.
- C. Use only those cleaning methods indicated for each masonry material and location.
  - 1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
  - 2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage surfaces, including joints.
    - a. Equip units with pressure gages.
    - b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
    - c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
    - d. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F at flow rates indicated.

SECTION 040110 - MASONRY  
CLEANING

- D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.
- E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed according to the "Cleaning Appearance Standard" Paragraph, so that cleaned surfaces blend smoothly into surrounding areas.
- F. Water-Spray Application Method: Unless otherwise indicated, hold spray nozzle at least 6 inches from masonry surface and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.
- G. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi . Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
- H. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.
  - 1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

3.3 PRELIMINARY CLEANING

- A. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar.
  - 1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
  - 2. Remove paint and calking with alkaline paint remover .
    - a. Comply with requirements in "Paint Removal" Article.
    - b. Repeat application up to two times if needed.
  - 3. Remove asphalt and tar with solvent-type paste paint remover .
    - a. Comply with requirements in "Paint Removal" Article.
    - b. Apply paint remover only to asphalt and tar by brush without prewetting.
    - c. Allow paint remover to remain on surface for 10 to 30 minutes.
    - d. Repeat application if needed.

3.4 PAINT REMOVAL

- A. Paint-Remover Application, General: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

SECTION 040110 - MASONRY  
CLEANING

B. Paint Removal with Covered or Skin-Forming Alkaline Paint Remover:

1. Remove loose and peeling paint using low -pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with trowel, spatula, or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with hot water applied by low -pressure spray to remove chemicals and paint residue.
7. Apply acidic cleaner or manufacturer's recommended afterwash to surface, while surface is still wet, using low-pressure spray equipment or soft-fiber brush. Let cleaner or afterwash remain on surface as a neutralizing agent for period recommended by chemical-cleaner or afterwash manufacturer.
8. Rinse with cold water applied by low -pressure spray to remove chemicals and soil.
9. Retreat spots of remaining paint.

3.5 CLEANING MASONRY

A. Detergent Cleaning:

1. Wet surface with hot water applied by low-pressure spray.
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold water applied by low -pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

END OF SECTION 040110

## SECTION 04 20 00 – UNIT MASONRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes thin brick units and related materials

1. Thin Brick
2. Mortar
3. Anchors and ties.
4. Embedded Flashing
5. Weepholes/Vents
6. Expansion Joints
7. Fasteners
8. Cleaning

B. Related Sections

1. Division 04 Section – “Unit Masonry”
5. Division 06 Section – “Rough Carpentry”
6. Division 06 Section – “Sheathing”
7. Division 07 Section – “Damp proofing and Waterproofing”
8. Division 07 Section – “Thermal Protection”
9. Division 07 Section – “Flashing and Sheet Metal”
10. Division 07 Section – “Joint Protection”

#### 1.2 REFERENCES

- A. ASTM A 240 – Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
- B. ASTM A 653 – Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
- C. ASTM A 925 – Standard Specification for Zinc 5% Aluminum Mischmetal Alloy Coated Steel Overhead Ground Wire Strand
- D. ASTM C 67 – Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
- E. ASTM C 126 – Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick and Solid Masonry Units
- F. ASTM C 270 – Standard Specification for Mortar for Unit Masonry
- G. ASTM C1405 – Standard Specification for Glazed Brick (Single Fired, Brick Units)

- H. ASTM C 1088 – Standard Specification for Thin Veneer Brick Units Made From Clay or Shale
- I. ASTM C 1330 – Standard Specification for Preblended Dry Mortar Mix for Unit Masonry

### 1.3 SUBMITTALS

- A. Submit under provisions of Section 013300
- 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
  - 1. Indicate masonry sizes, layout, patterns, corbels, racking, coursing, color arrangement, perimeter conditions, shape requirements and location, junctions with dissimilar materials, connections, and other related components.
  - 2. Locate and detail expansion and control joints.
- D. Samples: Furnish not less than five individual thin brick as samples for each thin brick specified, showing extreme variations in color and texture.

### 1.4 QUALITY ASSURANCE

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 unless modified by requirements in the Contract Documents.
- B. Comply with all applicable codes, regulations, and standards. Where provision of applicable codes, regulations, and standards conflict with requirements of this section, the more demanding shall govern.
- C. Manufacturer Qualifications:
  - 1. Obtain materials from one manufacturer to ensure compatibility.
  - 2. Obtain materials from company specializing in manufacturing products specified in this section with a minimum 5 years documented experience.
- D. Installer Qualifications:
  - 1. Proof of a minimum of five years experience with related thin masonry installations.
  - 2. At least one supervisory journeyman who shall be present at all times during execu-

tion of work, who shall be thoroughly familiar with design requirement, type of materials being installed, reference standards and other requirements, and who shall direct all work performed at jobsite.

E. Material Certificates: Prior to delivery, submit to Architect/Engineer certificates indicating compliance with the applicable specifications for Thin Brick Grades, Types or Classes included in these specifications.

F. Thin Brick Test Reports: Submit test reports substantiating compliance with requirements: Sample and test in accordance with ASTM C 67.

1. Testing and reports shall be completed by an independent laboratory.

a. Test reports for each type of thin brick shall be submitted to the Architect/Engineer for review.

b. Thin Brick Test reports shall indicate:

- 1) 2-hour cold water absorption
- 2) 5-hour boil absorption
- 3) Saturation coefficient
- 4) Initial rate of absorption
- 5) Efflorescence

G. Costs of Tests: Cost of tests shall be borne by the purchaser, unless tests indicate that units do not conform to the requirements of the specifications, in which case cost shall be borne by the seller.

H. Shop drawings: Submit individual drawings to be approved by Architect for special shaped thin brick units.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in dry location in manufacturer's unopened packaging until ready for installation.

B. Store all materials off the ground to prevent contamination by mud, dust or other materials likely to cause staining or other defects.

C. Protect materials from contamination, dampness, freezing, or overheating in accordance with manufacturer's instructions.

D. Store different types of materials separately.

#### 1.6 PROJECT CONDITIONS

A. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation.

B. Protection of Work:

1. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by material manufacturers for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
2. Stain Prevention:
  - a. Prevent grout or mortar from staining the face of masonry.
  - b. Remove immediately grout or mortar in contact with face of such masonry.
  - c. Protect all sills, ledges and projections from droppings of mortar.
  - d. Protect the wall from rain-splashed mud and mortar splatter by spreading coverings on ground and over wall surface.
  - e. Turn scaffold boards closest to the wall on edge when work is not in progress to prevent rain from splashing mortar and dirt onto masonry.

C. Cold Weather Requirements:

1. Do not use frozen materials or materials mixed or coated with ice or frost.
2. Do not build on frozen substrates.
3. Remove and replace unit masonry damaged by frost or by freezing conditions.
4. Comply with cold-weather construction

1.7 ALLOWANCES

- A. Allowance includes purchase of brick, taxes, delivery and any special handling charges.
- B. Special shaped brick units shall have a separate allowance.

**PART 2: PRODUCTS**

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not install units where such defects will be exposed in the completed work.

## 2.2 CLAY MASONRY UNITS

### A. General: Provide shapes indicated and as follows:

1. Provide special shapes for applications where flats (stretcher units) cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, shelf angles and lintels. Mitered units shall not be used at standard corners.
2. Provide special shapes for applications requiring thin brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
3. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

### B. All Thin Brick specified and shown on drawings shall be :

1. Thin Brick: ASTM C 1088, Grade Exterior Type TBX.
  - a. Size (height, length – actual dimensions listed)
    - 1) Modular Size: 2-1/4 inches (57.2 mm) high, 7-5/8 inches (193.7 mm) long.
  - b. Thickness: Manufacturers standard (1/2" min.)

## 2.3 MORTAR

### A. Mortar for thin brick

1. Mortar shall conform to ASTM C 270 Standard Specification for Mortar for Unit Masonry under the guidelines provided in BIA Technical Notes #8 Series.
  - a. Type S or N; as recommended by thin brick and thin brick backup construction manufacturer.

### B. Cold Weather Additives (including accelerators) shall not be used in thin brick mortar mix.

## 2.4 MASONRY CLEANERS

- A. Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces.

## 2.5 RELATED MATERIALS

### A. Embedded Flashing Materials

1. Metal Flashing: Provide metal flashing complying with Division 07 Section "Sheet

## Metal Flashing and Trim”.

- a. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch (0.40 mm) thick (minimum).
- b. Copper: ASTM B 370, Temper H00, cold-rolled copper sheet, 16-oz./sq. ft. (4.9-kg/sq. m) weight or 0.0216 inch (0.55 mm) thick or ASTM B 370, Temper H01, high-yield copper sheet, 12-oz./sq. ft. (3.7-kg/sq. m) weight or 0.0162 inch (0.41 mm) thick.
- c. Galvanized Sheet Steel: ASTM A653 0.024 inch (0.61 mm) (24-gauge) thick (minimum), with minimum ASTM A925 G-60 coating.
- d. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2-inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.

## 2. Flexible Flashing:

- a. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than [0.030 inch (0.76 mm)] [0.040 inch (1.02 mm)].
- b. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy as follows:
  - 1) Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040 inch (1.0 mm) thick.
  - 2) Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 inch (0.6 mm) thick, with a 0.015-inch-(0.4-mm-) thick coating of rubberized-asphalt adhesive.
- c. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer’s standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

## B. Weepholes:

1. Rope Wicks: Cotton Sash Cord, 12 inches long with end laid in cavity.
2. Plastic Tubes: 1/4 inch (6 mm) minimum inside diameter by 4 inches (102 mm) long.
3. Aluminum Weep/Vents.
4. Plastic Weep/Vents.

## C. Expansion Joints

1. Compressible Filler: pre-molded filler strips complying with ASTM D 1056, Type 2, Class A, Grade 1 formulated from neoprene.
2. Backer Rod: Non-gassing polyethylene or flexible polyurethane foam rod 25% wider than width of joint to be filled.

## **PART 3: EXECUTION**

### **3.1 EXAMINATION**

- A. Do not begin installation until substrates and foundations as well as rough-in and built-in construction have been properly prepared.
  1. Walls must be structurally sound and the substrate system designed with a wall deflection not greater than L/360.
- B. Verify substrate including, concrete, masonry or framing as well as sheathings, water resistant barriers are properly installed.
- C. If substrate, foundations or flashings are the responsibility of another installer, notify Architect and General contractor of unsatisfactory preparation before proceeding.

### **3.2 PREPARATION**

- A. Clean surfaces thoroughly prior to installation. All surfaces must be free of water, snow, dirt, mud, oil and other foreign materials 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. Trim or flash in place per manufacturer's details and/or BIA Technical Note 7A on flashing of Brick Walls.

### **3.3 INSTALLATION**

- A. Install Thin Brick in accordance with manufacturers written installation instructions.
- B. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement joints, returns, and offsets.
  1. Avoid using less-than-half-size units, particularly at corners and jambs.
  2. Ensure unfinished or cut faces are not exposed to view upon completion.
- C. Select and arrange exposed masonry units to produce a uniform blend of color and texture.
  1. Mix units from several pallets or cubes as they are placed.

- D. Lay masonry in bond pattern as indicated on drawings or general notes.
- E. Comply with tolerances in TMS 602/ACI 530.1/ASCE 6.

### 3.4 TOOLING AND POINTING

- A. Joint Profile: Tool mortar joints to a concave appearance.
- B. Tool exposed joints when "thumb-print" hard.
- C. Flush cut all joints not tooled.
- D. When pointing, rake mortar joints to a depth of not less than 1/2 inch (12 mm). Fill solidly with pointing mortar. Tool joints.

### 3.5 FLASHING

- A. Clean surface of masonry from projections which might puncture flashing.
- B. Place through-wall flashing on bed of mortar.
- C. Cover flashing with mortar.
- D. Lap flashing a minimum of 6 inches (152 mm).
- E. Leave flashing project from face of wall approximately 1/4 inch (6 mm) to form a drip. Flashing shall be cut back to the face of the wall after inspection, if the drip is deemed objectionable by Architect

### 3.6 WEEPHOLES

- A. Provide weep holes in head joints of the first brick course immediately above flashing by placing weeps no more than 24 inches (610 mm) on center horizontally.
- B. Keep cavity free from mortar.

### 3.7 EXPANSION JOINTS

- A. Keep clean from all mortar and debris.
- B. Locate as shown on drawing, if not shown on drawings space expansion joint maximum 50 feet.
- C. Install neoprene pre-molded foam pad.

- D. Install backer rod.
- E. Install sealant. Prime surfaces if necessary.

### 3.8 CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove adhesive as well as mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Cut out all defective mortar joints and holes in exposed masonry and provide new mortar.
  - 2. Clean preselected sample wall area with specified cleaning solution as per manufacturer's recommendations. Do not proceed with cleaning until approved by Architect.
  - 3. Clean thin brick in accordance with manufacturer's written instructions.
  - 4. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 5. All cleaning practices and product used shall be in accordance with cleaning products manufacturer's written instructions.

**END OF SECTION 04 20 00**

## **SECTION 04 25 16 – THIN BRICK MASONRY SYSTEM**

### **PART 1: GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes: TABS Wall Systems Panel System and related materials.
  - 1. Thin Brick.

#### **1.2 SUBMITTALS**

- A. Submit under provisions of Section 013300.
- 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
  - 1. Indicate masonry layout, patterns, color arrangement, perimeter conditions, shape requirements, junctions with dissimilar materials, connections, and other related components.
  - 2. Locate and detail expansion and control joints.
- D. Samples: Furnish not less than five (5) individual masonry units as samples, showing extreme variations in color and texture.

#### **1.3 QUALITY ASSURANCE**

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 unless modified by requirements in the Contract Documents.
- B. Comply with all applicable codes, regulations, and standards. Where provision of applicable codes, regulations, and standards conflict with requirements of this section the more demanding shall govern.
- C. Metal Panel
  - 1. Obtain materials from one manufacturer to ensure compatibility
  - 2. Manufacturer's Qualifications
    - a. A history of corporate experience with metal supported unit masonry panels.

- b. Documented qualifications and capabilities that fully describe the ability to provide the required metal panel system and technical support to the Owner.
  - c. At least five (5) years thin brick metal system experience or TABS certified with a related masonry support system.
3. Testing and reports shall be completed by an independent laboratory.
- a. Test reports for the panels shall be submitted to the Architect/Engineer for review.
  - b. Metal panel shall meet or exceed the following performance standards:
    - (1) ASTM E-297-99 SHEAR BOND STRENGTH TEST OF MASTIC
    - (2) AFG -01 MASTIC
    - (3) ASTM D 3-498 MASTIC
    - (4) ASTM E-72 WINDLOAD TEST OF BUILDING PANELS
    - (5) ASTM E-119-00 FIRE RESISTANCE TEST
    - (6) ASTM-84-03 SURFACE BURN SPREAD & SMOKE DEVELOPMENT
    - (7) ASTM B-117-03 1000 HOUR SALT SPRAY TEST
    - (8) ASTM D1037-99 NAIL-HEAD PULL-THROUGH
    - (9) ASTM E 2273-03 PER EG356-2006 WATER DRAINAGE
    - (10) ICC-ES EG356 3.1.6 ACCELERATED WEATHERING
    - (11) ASTM E96-05 ICC-ES EG356 SECTION 3.1.3 WATER VAPOR TRANSMISSION
    - (12) ASTM C1338-02 ICC-ES EG356 SECTION 3.1.1 FUNGI

D. Installer Qualifications:

- 1. Authorized TABS Wall Systems installer or proof of a minimum of five years experience with a related thin masonry support panel system.
- 2. At least one supervisory journeyman who shall be present at all times during execution of work, who shall be thoroughly familiar with design requirement, type of materials being installed, reference standards and other requirements, and who shall direct all work performed at jobsite.

E. Material Certificates: Prior to delivery site, submit to Architect/Engineer certificates indicating compliance with the applicable specifications for Thin Brick Grades, Types or Classes included in these specifications.

**1.4 DELIVERY, STORAGE AND HANDLING**

- A. Deliver materials in manufacturer's unopened containers, identified with name, brand, type, and grade.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store TABS Wall Systems Panels and accessories off the ground, to prevent contamination by mud, dust or other materials likely to cause staining or other defects.

- D. Protect materials from contamination, dampness, freezing, or overheating in accordance with manufacturer's instructions.
- E. Store different types of materials separately.
- F. Mastic and mortar additive are to be stored above 32° Fahrenheit and below 86° Fahrenheit temperatures & no direct sun light.
- G. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

## **1.5 PROJECT CONDITIONS**

- A. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation.
- B. Protection of Work:
  - 1. 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.
  - 2. Stain Prevention:
    - a. Prevent adhesive, and mortar from staining the face of masonry.
    - b. Remove immediately grout or mortar in contact with face of such masonry.
    - c. To avoid smearing of adhesive on the face of masonry. Allow adhesive on face of installed masonry to set before trying to remove.
    - d. Protect all sills, ledges and projections from droppings of adhesive or mortar.
    - e. Protect the wall from rain-splashed mud and mortar splatter.
    - f. Turn scaffold boards closest to the wall on edge when work is not in progress to prevent rain from splashing mortar and dirt onto masonry.
- C. Cold Weather Requirements:
  - 1. Do not use frozen materials or materials mixed or coated with ice or frost.
  - 2. Do not build on frozen substrates.
  - 3. Remove and replace unit masonry damaged by frost or by freezing conditions.
  - 4. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE
  - 5. Comply with TABS adhesive application and temperature requirements as stated in the TABS installation manual.
- D. Hot Weather Requirements:
  - 1. Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE
  - 2. Protect mortar from uneven and excessive evaporation.

- a. The face of the installed thin brick may be dampened with water prior mortar installation to reduce the absorption of moisture from the mortar joint and increase bond
  - b. Veneer may be fogged with water to allow the mortar enough time to set. Apply only enough moisture to consistently dampen the wall without allowing water to run down the face.
3. Comply with Tabs Wall Systems application and temperature requirements.
  4. Protect and shade panels from extended exposure direct sun. Excessive head gain can cause adhesive to flow.

## **PART 2: PRODUCTS**

### **2.1.1 METAL MASONRY SUPPORT PANEL, GENERAL**

- A. Metal Masonry Support Panel intended for the interior or exterior structural mechanical support of thin veneer on concrete, masonry, metal or frame construction. Structural grade 33 (.018) steel with G90 galvanized thermal set coating and stucco embossed texture with Tabs support & mortar locking ties.

### **2.1.2 MANUFACTURERS**

- A. Acceptable Manufacturer: TABS Wall Systems, LLC located at: • 4515 Airwest Dr SE • Grand Rapids, MI 49512 • 616-554-5400 • Web: [www.tabswallsystems.com](http://www.tabswallsystems.com)
- B. Substitutions: An approved equal. Material substitution to be approved by Architect and Construction Manager before award of contract.

### **2.1.3 METAL MASONRY SUPPORT PANELS**

- A. All Metal Panels for Thin Brick Support specified and shown on drawings shall be TABS Wall Panel as manufactured by the TABS Wall Systems Corporation.

1. Flat Panels: 16-square foot (1.44 m<sup>2</sup>) masonry support panels for flat wall areas 48-inch (1,219.2 mm) x 48-inch (1,219.2 mm) nominal (see below), shall have support spacing as follows (actual dimensions listed):

Available Sizes: TABS lengths 5/16" (7.9375 mm), 9/16" (14.2875mm)

- a. 2-5/8 inch (66.675 mm) for Modular, standard, Norman, and other 2-1/4" (57.2mm) high units. TABS II panel size: 47 7/8" (1193.8 mm) x 48" (1,219.2 mm) • TABS IP panel size: 47 7/8" (1,193.8 mm) x 48" (1,219.2 mm)

- b. 2-5/8 inch (66.675 mm) for Modular, standard, Norman, and other 2-1/4" (57.2mm) high units .TABS II panel size: 23 7/8" (752/475 mm) x 48" (1,219.2mm) • TABS IP size: 23 7/8" (752.475mm) x 48" (1,219.2 mm)
  - c. 12-inch (304.8 mm) for 11-5/8" (295.3 mm) high units. TABS II panel size: 47 7/8" (1,193.8mm) x 48" (1,219.2 mm)
- B. Pre-Bent Corner Panels: 8-square foot (1.44 m2) masonry support panels for external corner applications 24-inch high (nominal) with 16-inch (406 mm) leg and 32-inch (813 mm) leg or 24 x 24.
- 1). Support spacing to match flat panels specified above.

### 2.2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed work.

### 2.2.2 MANUFACTURERS

- A. See Specification Sections 042000 and 047200.

### 2.2.3 CLAY MASONRY UNITS

- A. General: Provide shapes indicated and as follows:
1. Provide special shapes for applications where flats (stretcher units) cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, shelf angles and lintels. Mitered units shall not be used at standard corners.
  2. Provide special shapes for applications requiring thin brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
  3. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. All Thin Brick specified and shown on drawings shall be [Add thin brick product Manufacturer's name(s) here]
1. Thin Brick: ASTM C 1088, Grade Exterior
    - a. Type TBX
    - b. Size (height, length - actual dimensions listed)
      - 1) Modular Size: 2-1/4 inches (57.2 mm) high, 7-5/8 inches (193.7 mm) long
    - c. Thickness: Manufacturer standard (1/2" min.)

## **2.3 MORTAR**

### **A. Mortar for thin brick**

1. Mortar shall conform to ASTM C 270 Standard Specification for Mortar for Unit Masonry under the guidelines provided in BIA Technical Notes #8 Series.

### **B. Cold Weather Additives (including accelerators) shall not be used in thin brick mortar mix.**

## **2.4 EMBEDDED FLASHING MATERIALS**

### **A. Metal Flashing:**

1. TABS Wall System Starter Angle: Minimum Galvanized sheet steel: ASTM A653 0.024 inch (0.61) (26 gauge), minimum ASTM A925 G-90 coating or Stainless Steel: ASTM A 240/A 240M, Type 304, G-90 & Paint finish 0.019 inch (0.45mm) (24 gauge), present in 8 or 10 ft. (304.8 cm) lengths.

### **B. Flexible Flashing:**

1. Rubberized Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than [0.030 inch (0.76 mm)] [0.04 inch (1.02 mm)].
2. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene inter polymer alloy as follows:
  - a. Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040 inch (1.0 mm) thick.
  - b. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 inch (0.6 mm) thick, with a 0.015-inch- (0.4-mm-)thick coating of rubberized-asphalt adhesive.
3. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

## **2.5 Weep holes & Venting**

- ### **A. Standard weep holes for draining wall panels can be formed by omitting mortar/sealant at intervals of one.**

## **2.6 Control Joints & Expansion Joints**

- A. Control joints in the panel system are required to coincide with the building control joints where substrates change, within 2' - 4' of outside corners, 25' to 30' for steel stud framing. Horizontal control joints should be every one to two stories for steel stud framing and every one story for wood stud framing. Control joints should be to regional building code standards, but not to exceed 24' in height.

## **2.7 Fasteners**

- A. Screw fasteners shall be to panel manufacturers standard installation procedures and to meet NYS Building Construction Code.
- B. Fasteners to mount the panel shall be TabGard for use on wood or steel stud installations; or TabCon for use on masonry installations, supplied by Tabs Wall Systems, LLC or equal.
- C. Fasteners Length:
  - 3. Steel studs, girts or purlins: Self tapping/self drilling fasteners shall penetrate a minimum 1/4" (6.4 mm), or not less than three exposed threads behind the stud flange, girt or purlin.

## **2.8 ADHESIVE**

- A. Tabs Adhesive for thin clay brick or concrete masonry unit
  - 1. High-strength mastics must exceed ASTM D3498 and ASTM C557 TABS adhesive manufacturer's specifications for TABS with less than 70 grams of VOC per liter with a shear value between the thin veneer and the panel greater than 100 PSI (10.5 kg/cm<sup>2</sup>).
- B. Tabs Structural Silicone for natural stone, cast stone or marble

## **2.9 SHEATHING**

- A. Provide sheathing, as designated in section 060000.
- B. Sheathing shall be one of the following as deemed suitable for specific project conditions:
  - 1. 1/2" Structural Wood Panel.

## **2.10 WEATHER BARRIERS**

- A. Water Infiltration barrier shall be Green Guard RainDrop Wrap by Tabs Wall Systems, LLC or equal.

## 2.11 CLEANING

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Diedrich Technologies, Inc.

a. 202 New Masonry Detergent

b. 202V Vana -Stop®

## PART 3: EXECUTION

### 3.1 EXAMINATION

A. Do not begin installation until substrates and foundations as well as rough-in and built-in construction have been properly prepared.

1. Walls must be structurally sound and the substrate system designed with a wall deflection not greater than  $L/360$ .

a. Maximum wall frame spacing for stud walls = 406.4 mm (16") O.C.

b. Maximum wall frame spacing for girts = 762 mm (30") O.C.

c. Minimum 0.043 inch (18-gauge; 1.09 mm) studs for exterior walls.

2. Substrate shall have no planer irregularities greater than 7 mm in 3.05 m (1/4" in 10').

B. Verify substrate including, concrete, masonry or framing as well as sheathings and weather barrier are properly installed. TABS Wall Systems Support Panel Guide Specification

C. Verify walls are plumb and corners are braced to specifications.

D. Substrate must be flat, within 1/8-inch (3.2 mm) within any 4-foot (1.2 m) square area with no planar irregularities greater than 1/4" per 10 linear feet.

E. If substrate, foundations or flashings are the responsibility of another installer; notify Architect and also owner, General contractor of unsatisfactory preparation before proceeding.

### **3.2 PREPARATION**

- A. Clean surfaces thoroughly prior to installation. All surfaces must be free of water, snow & frost, dirt, mud, oil and other foreign materials 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. Trim or flash in place per manufacturer's details and/or BIA Technical Note 7A on flashing of Brick Walls.

### **3.3 INSTALLATION, GENERAL**

- A. Install materials in accordance with manufacturer's instructions.
- B. Select and arrange exposed masonry units to produce a uniform blend of color and texture.
  - 1. Mix units from several pallets or cubes as they are placed.
- C. Comply with tolerances in [TMS 602/ACI 530.1/ASCE 6.]

### **3.4 TABS PANEL SYSTEM**

- A. Install in accordance with manufacturer's written instructions as applicable to each type of substrate required.
- B. Trim, starter angle and flashing shall be installed prior to panel installation.
- C. Walls shall be constructed of structurally sound masonry, wood, or steel studs, with an approved building sheathing and weather resistant barriers as required.
- D. Panels shall be clean, free of dirt, oil or any other foreign contaminant.
- E. Lay out panels in advance for accurate spacing of tabs to allow installation of full height masonry units at top and bottom of walls, openings, etc. when possible. Note: Panel sizes will vary depending on spacing.
- F. Attach panels flat to the substrate in true and level rows with support ties aligned and level to each other at flat sections as well as corners.
- G. Stagger metal panel joints over sheathing joints. This requires cutting 1/2 panels when starting at outside or inside corners. When using pre bent corner panels, stagger joints of flat panels after corner panel installation for control joint placement.
- H. Do not allow panels to bridge movement joints in substrate.

I. Install full-size uncut panels when possible. When cutting is required to provide staggered panel joints or to fit specific application, cut panels to provide clean, unbent edges.

J. Install panels to ensure a 1/16" – 1/8" gap between the sides of the panels and butt panels vertically, always leaving a gap at movement joints locations equal to the thickness of the joint.

K. Stop panel 1/4" to 3/8" from inside corners, openings and other materials to allow for movement.

L. Fastener Installation: Mechanically attach metal panels with a minimum of 1.5 fasteners per square foot (16 sf = 24 fasteners) increasing spacing along the top and bottom of the wall and around openings.

#### M. TABS Wall Systems Panel Guide Specification

1. Horizontal fastener spacing shall not exceed 24 inches; vertical fastener spacing shall not exceed 16 inches.

2. Provide additional anchors around the perimeter of walls as well as openings (406 mm) in either dimension, as well as building corners not utilizing corner panels as follows:

a. Install fasteners a minimum of 3 per square foot (900 cm<sup>2</sup>).

i. At the top and bottom of the walls, fasteners shall be spaced a maximum of 16 inches (305 mm) horizontally and within the height of a single row or course of masonry.

ii. At vertical wall ends of wall and openings, fasteners shall be spaced a maximum of 8 inches vertically within 4 inches of the end of the panel.

### 3.5 FASTENERS

A. Attach fasteners to the framing through the sheathing.

B. Fasteners for wood frame shall penetrate the studs a minimum of 1" (25 mm).

C. Fasteners for steel studs, girts or purlins shall penetrate a minimum 1/4" (6.4 mm) with not less than three expose threads behind the steel members.

### **3.6 THIN VENEERS**

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement joints, returns, and offsets.

1. Avoid using less-than-half-size units, particularly at corners and jambs.

2. Ensure unfinished or cut faces are not exposed to view upon completion.

B. Select and arrange units for exposed unit masonry to produce a uniform blend of color and texture.

C. Lay masonry in bond pattern as indicated on drawings or general notes.

D. Back face of thin brick must be dry and clean; free of dirt, oil or any other foreign contaminant.

E. Leave a uniform 3/8 - 1/2-inch (9.5 - 12.7 mm) gap at openings to allow for movement joint installation.

F. Adhere individual units to panel using TABS adhesive placed on the back of the units in two 1/2 - 3/4-inch dabs or vertical strips 3/8-inch wide. For corner brick apply one dab on head and one dab at each end of the long leg.

1. Do not apply adhesive in a manner that would create horizontal strips of adhesive that may prevent moisture from draining down the wall.

2. Do not use excessive adhesive as this will cause thin brick to tilt away from wall prior to adhesive set.

G. Thin veneers shall be applied within 10 minutes after adhesive has been applied and before film begins to form on the adhesive. Silicone needs to set until film has been formed a minimum of 5 minutes.

H. Space thin brick to ensure that the head joints do not exceed 5/8-inch (16 mm) or fall below 1/4-inch (6.4 mm).

I. When adjustment is necessary to be made after adhesive begins to harden, remove hardened adhesive and replace with fresh adhesive.

J. Keep areas intended to receive sealant clean of thin brick, adhesive and other materials during construction.

K. Do not allow masonry units to bridge movement joints in substrate.

### **3.7 MORTAR INSTALLATION AND JOINTING**

A. After adhesive has set a minimum of 12 hours, completely fill head and bed joints between adhered veneers intended to receive mortar.

B. Keep weep holes free of mortar every 24 inches immediately above starter angles and flashings.

C. Tool exposed joints when thumbprint hard to joint profile listed below:

1. Joint Profile: Tool mortar joints to a concave appearance.
2. Joint Profile: Tool mortar joints to a concave grapevine appearance.

D. Flush cut all joints not tooled.

E. When repointing, completely remove mortar, and refill solidly with pointing mortar, and tool joints.

### **3.8 FLASHING**

A. Install embedded flashing and weep holes in Tabs Wall panel assemblies at the base of the wall, above openings, above horizontal movement joints, and other obstructions to the downward flow of water in wall, and where indicated.

B. Before covering with wall panel or mortar, seal penetrations in flashing with adhesive, sealant, or flashing tape as recommended by flashing tape manufacturer.

C. Carry flashing vertically as detailed, but not less than 3 inches (76 mm) above horizontal plane.

D. Lap flashing a minimum of 3 inches (76 mm).

E. Seal all flashing laps with approved TABS Wall Systems tapes.

F. Extend head and sill flashings not less than 6 inches (150 mm) beyond edges of openings; seal with TABS flashing tape.

H. Project starter angle from face of wall with a minimum 5/8-inch (6 mm) to form a drip.

### **3.9 WEEP HOLES**

A. Install weep holes every 24" in head joints at all flashings.

B. Keep vents and weep holes free of mortar.

C. Weep holes (in areas where vents are not installed or specified): Install weep holes to drain moisture from the wall by omitting mortar/sealant a maximum of 24 inches (610 mm) on center horizontally for units 12" (305 mm) or less in length and a maximum of 32" (813 mm) on center for larger units, in the joint between the flashing and thin brick above or in the lower third of the head joints immediately above the starter angles and flashings, including the base of the wall, at horizontal expansion joints and above all openings.

### **3.10 CONTROL AND EXPANSION JOINTS**

- A. Keep clean of all mortar, adhesive and debris.
- B. Locate joints where indicated on drawings.
- C. Provide vertical and horizontal pressure-relieving joints where indicated by installing sealant, and inserting a compressible filler when required, as specified in Division 07 Section "Joint Sealants," but not less than 3/8-inch(10 mm). Backer rod may not be required and is dependent upon depth of joint.
- D. Install joints between TABS Wall Systems wall assemblies and other materials including around windows and doors.
- E. Install joints at changes in substrate, unlike materials and where movement joints occur in substrate.
- F. Vertical joints must not exceed 16-feet (488 cm) on center in walls without openings; including joint within 4 ft. (122 cm) of the corner.
- G. Install horizontal joints on wood frame walls at every floor level.
- I. For wood construction framing, vertical control joints must be installed at 2' on both sides of outside corners.

### **3.11 CLEANING**

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove adhesive as well as mortar and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Cut out all defective mortar joints and holes in exposed masonry and provide new mortar.
  - 2. Clean preselected sample wall area with specified cleaning solution as per manufacturer's recommendations. Do not proceed with cleaning until approved by Architect.
  - 3. Clean thin brick in accordance with manufacturer's written instructions.
  - 4. Protect adjacent stone and non masonry surfaces from contact with cleaner.
  - 5. All cleaning practices and product used shall be in accordance with cleaning products manufacturer's written for further instructions.

**END OF SECTION 04 25 16**

SECTION 047200 - CAST  
STONE MASONRY

SECTION 047200 - CAST STONE MASONRY

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. Trim units.
  - 2. Decorative elements.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.
- C. Samples:
  - 1. For each color and texture of cast stone required, 4 inches square in size.

1.4 INFORMATIONAL SUBMITTALS

- A. Material test reports.

PART 2 - PRODUCTS

2.1 CAST STONE UNITS

- A. Cast Stone Units: Comply with ASTM C1364.
  - 1. Units shall be manufactured using the manufacturer's selected method.
  - 2. Trim units including **[window sills]** **[lintels]** **[surrounds]** **[mullions]** **[copings]** **[cornices]** **[wall caps]** **[belt courses]** **[water tables]** **[quoins]** **[keystones]** **[items as indicated on Drawings]**.
  - 3. Decorative elements including items as indicated on Drawings.

SECTION 047200 - CAST  
STONE MASONRY

- B. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
  - 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
  - 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
  - 3. Provide drips on projecting elements unless otherwise indicated.
- C. Cure Units as Follows:
  - 1. Cure units in enclosed, moist curing room at 95 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
  - 2. Keep units damp and continue curing to comply with one of the following:
    - a. No fewer than five days at mean daily temperature of 70 deg F or above.
    - b. No fewer than seven days at mean daily temperature of 50 deg F or above.
- D. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
- E. Colors and Textures: As selected by Architect from manufacturer's full range .

## 2.2 MORTAR MIXES

- A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.
- B. Comply with ASTM C270, Proportion Specification.
  - 1. For setting mortar, use Type S .
  - 2. For pointing mortar, use Type N .
- C. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

## PART 3 - EXECUTION

### 3.1 SETTING CAST STONE IN MORTAR

- A. Set cast stone as indicated in TMS 604.
- B. Install cast stone units to comply with requirements in Section 042000 "Unit Masonry."
- C. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
- D. Set units in full bed of mortar with full head joints unless otherwise indicated.
  - 1. Fill dowel holes and anchor slots with mortar.
  - 2. Fill collar joints solid as units are set.
  - 3. Build concealed flashing into mortar joints as units are set.
  - 4. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.

SECTION 047200 - CAST  
STONE MASONRY

5. Keep joints at shelf angles open to receive sealant.
- E. Rake out joints for pointing with mortar to depths of not less than 3/4 inch. Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.
- F. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- G. Tool exposed joints slightly concave when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.
- H. Rake out joints for pointing with sealant to depths of not less than 3/4 inch. Scrub faces of units to remove excess mortar as joints are raked.
- I. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.
  1. Keep joints free of mortar and other rigid materials.
  2. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.2 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/4 inch in 10 ft. , , or 1/2 inch maximum.
- B. Variation from Level: Do not exceed 1/4 inch in 10 ft. , , or 1/2 inch maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.
- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch, except where variation is due to warpage of units within tolerances specified.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean cast stone as work progresses.
  1. Remove mortar fins and smears before tooling joints.
  2. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:

SECTION 047200 - CAST  
STONE MASONRY

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
5. Clean cast stone by methods described in Cast Stone Institute Technical Bulletin #39.
6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 047200

SECTION 055213 - PIPE AND  
TUBE RAILINGS

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel railings.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's product lines of mechanically connected railings.
2. Handrail brackets.
3. Shop primer.
4. Intermediate coats and topcoats.
5. Bituminous paint.
6. Metal finishes.
7. Paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1.3 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:
  - a. Uniform load of 50 lbf/ ft. applied in any direction.
  - b. Concentrated load of 200 lbf applied in any direction.
  - c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Infill of Guards:
  - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
  - b. Infill load and other loads need not be assumed to act concurrently.

SECTION 055213 - PIPE AND  
TUBE RAILINGS

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
  - 1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.3 STEEL RAILINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Hollaender Mfg. Co.
  - 2. Kee Safety, Inc.
  - 3. R & B Wagner, Inc.
  - 4. Trex Commercial Products, Inc.
  - 5. Tuttle, a Dant Clayton Division.
  - 6. VIVA Railings, LLC.
- B. Tubing: ASTM A500/A500M (cold formed) .
- C. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  - 1. Provide galvanized finish for exterior installations and where indicated.
- D. Plates, Shapes, and Bars: ASTM A36/A36M.

2.4 FASTENERS

- A. Fastener Materials:
  - 1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941, Class Fe/Zn 5 for zinc coating.
  - 2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
- B. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
  - 1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

SECTION 055213 - PIPE AND  
TUBE RAILINGS

2.5 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: Cast stainless steel, Cast nickel-silver, center of handrail 2-1/2 inches from face of railing or wall.
- B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
  - 1. For aluminum and stainless steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint, complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- F. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- H. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
  - 1. Water-Resistant Product: At exterior locations and where indicated on Drawings, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

- A. Cut, drill, and punch metals cleanly and accurately.
  - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
  - 2. Remove sharp or rough areas on exposed surfaces.
- B. Form work true to line and level with accurate angles and surfaces.
- C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

SECTION 055213 - PIPE AND  
TUBE RAILINGS

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove flux immediately.
  4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint
- D. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- E. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- F. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
- I. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
  2. Coordinate anchorage devices with supporting structure.
- J. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- K. For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height.
1. Provide socket covers designed and fabricated to resist being dislodged.
  2. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- L. Expanded-Metal Infill Panels: Fabricate infill panels from expanded-metal sheet of same metal as railings.
1. Orient expanded metal with long dimension of diamonds parallel to top rail .
- M. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch metal channel frames.

SECTION 055213 - PIPE AND  
TUBE RAILINGS

1. Fabricate wire mesh and frames from same metal as railings in which they are installed.
2. Orient wire mesh with wires perpendicular and parallel to top rail .

N. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner and as follows.

1. Comply with SSPC-SP 16.

D. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1 for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

SECTION 055213 - PIPE AND  
TUBE RAILINGS

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Anchor posts to metal surfaces with flanges, angle type, or floor type, as required by conditions, connected to posts and to metal supporting members as follows:

3.3 ATTACHING RAILINGS

- A. Attach handrails to walls with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
- B. Secure wall brackets and railing end flanges to building construction as follows:
  1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  2. For hollow masonry anchorage, use toggle bolts.
- C. Touchup Painting:
  1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

3.4 CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055213

## SECTION 061000 - ROUGH CARPENTRY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Framing with dimension lumber.
  - 2. Wood blocking and nailers.
  - 3. Wood furring and grounds.
  - 4. Plywood backing panels.

#### 1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
  - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
  - 2. NLGA: National Lumber Grades Authority.
  - 3. SPIB: The Southern Pine Inspection Bureau.
  - 4. WCLIB: West Coast Lumber Inspection Bureau.
  - 5. WWPA: Western Wood Products Association.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
- B. Fastener Patterns: Full-size templates for fasteners in exposed framing.
- C. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

## 1.6 PROJECT CONDITIONS:

- A. The limestone exterior wall, including historic mortar dates to 1863. The wall has been subjected to significant water infiltration and is wet. Due diligence must be given to ensure the wall is sufficiently dry to accept the work of this section. Coordinate with work of Section 040120 Limestone Restoration.

## PART 2 - PRODUCTS

### 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
  - 3. Provide dressed lumber, S4S, unless otherwise indicated.

### 2.2 DIMENSION LUMBER FRAMING

- A. Maximum Moisture Content: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness.
- B. Joists, Rafters, and Other Framing Not Listed Elsewhere: No. 2 or better grade of the following species:
  - 1. Hem-fir (north); NLGA.
  - 2. Douglas fir-larch; WCLIB or WWPA.
  - 3. Spruce-pine-fir; NLGA.
  - 4. Douglas fir-south; WWPA.
  - 5. Hem-fir; WCLIB or WWPA.
  - 6. Douglas fir-larch (north); NLGA.
  - 7. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

### 2.3 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
  2. Nailers.
  3. Furring.
  4. Grounds.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content of the following species:
1. Hem-fir (north); NLGA.
  2. Mixed southern pine; SPIB.
  3. Spruce-pine-fir; NLGA.
  4. Hem-fir; WCLIB, or WWPA.
  5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
  6. Western woods; WCLIB or WWPA.
  7. Northern species; NLGA.
  8. Eastern softwoods; NeLMA.
- C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

## 2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

## 2.5 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Alpine Engineered Products, Inc.
  2. Cleveland Steel Specialty Co.
  3. Harlen Metal Products, Inc.
  4. KC Metals Products, Inc.
  5. Simpson Strong-Tie Co., Inc.
  6. Southeastern Metals Manufacturing Co., Inc.
  7. USP Structural Connectors.
  8. Or approved equal.
- B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 coating designation. Use for interior locations where stainless steel is not indicated.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304. Use for exterior locations and where indicated.
- E. Bridging: Rigid, V-section, nailless type, 0.050 inch thick, length to suit joist size and spacing.
- F. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2 inches wide by 0.050 inch thick. Tie fastens to side of rafter or truss, face of top plates, and side of stud below.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction".
- C. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions.

- D. Do not splice structural members between supports.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- F. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- H. Use common wire nails. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads.

### 3.2 WOOD BLOCKING AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

### 3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- size furring horizontally and vertically at 24 inches o.c.
- C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- size furring vertically at 16 inches o.c.

### 3.4 RAFTER FRAMING INSTALLATION

- A. Rafters: Notch to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal

hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.

1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against valley rafters.
2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against hip rafter.

B. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions.

### 3.5 PROTECTION

- A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

## SECTION 061753 – SHOP-FABRICATED WOOD TRUSSES

### PART 1 - GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

- A. This section includes the following:

1. Gable-shaped trusses.
2. Hip and Girder Trusses at hip ends of roof.
3. Jack Trusses at Hip Ends.
4. Prefabricated Wood Floor Trusses.

- B. Sheathing is specified in Division-6 section "Rough Carpentry".

#### 1.03 RELATED WORK

- A. Related Work Specified Elsewhere:

1. Section 06100: Rough Carpentry

#### 1.04 DEFINITIONS

- A. Prefabricated metal plate connected wood trusses include planar structural units consisting of metal plate connected members that are fabricated from dimension lumber and that have been cut and assembled prior to delivery to the project site.

#### 1.05 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.
- B. Product Data for lumber, metal connector plates, hardware, fabrication process, and fasteners.
- C. Shop Drawings indicating species, species group, sizes, and stress grades of lumber to be used; pitch, span, camber, configuration and spacing for each type of truss required; type, size, material, finish, design values, and location of metal connector plates; and bearing and anchorage details.
  1. To the extent engineering design considerations are indicated as fabricator's responsibility, include design analysis indicating loading, assumed allowable stress, stress diagrams, and calculations, and other information needed for review that have been signed and sealed by a qualified Professional Engineer, licensed to practice in the jurisdiction where the trusses will be installed, responsible for their preparation.
  2. Provide shop drawings which have been signed and sealed by a qualified Professional Engineer, licensed to practice in the jurisdiction where the trusses will be installed, responsible for their preparation.
- D. Product Certificate, signed by officer of fabricating firm, certifying that metal plate connected wood trusses supplied for Project comply with specified requirements.

#### 1.06 QUALITY ASSURANCE

- A. TPI Standards: Comply with applicable requirements and recommendations of the following Truss Plate Institute (TPI) publications:
  - 1. "Design Specification for Metal Plate Connected Wood Trusses".
  - 2. "Commentary and Recommendations for Handling and Erecting Wood Trusses".
  - 3. "Commentary and Recommendations for Bracing Wood Trusses".
  - 4. "Quality Standard for Metal Plate Connected Wood Trusses".
- B. Connector Plate Manufacturer's Qualifications: A manufacturer that is a member of TPI and that complies with TPI quality control procedures for manufacture of connector plates published in TPI Ref. 4 above.
- C. Wood Structural Design Standard: Comply with applicable requirements of NFPA "National Design Specification for Wood Construction".
- D. Engineer Qualifications: A Professional Engineer legally authorized to practice in jurisdiction where Project is located and experienced in providing structural engineering services of the kind indicated that have resulted in the installation of metal plate connected wood trusses similar to those of this Project and with a record of successful in-service performance.
- E. Fabricator's Qualifications: A firm that complies with the following requirements for quality control and is experienced in prefabricating metal plate connected wood trusses similar to those of this Project that have a record of successful in-service performance:
  - 1. Fabricator participates in a recognized quality assurance program that involves inspection by SPIB; Timber Products Inspection, Inc.; Truss Plate Institute; or other independent inspection and testing agency acceptable to Architect.
- F. Single Source Responsibility for Connector Plates and hangers: Provide metal connector plates from a single manufacturer; provide truss hangers from a single manufacturer.
- G. Limit roof truss deflections to L/240 Total load and Floor truss deflections to L/480 Live Load.

#### 1.07 DELIVERY, STORAGE AND HANDLING

- A. Handle and store trusses with care, and comply with manufacturer's instructions and TPI recommendations to avoid damage from bending, overturning or other cause which trusses are not designed to resist or endure.

#### 1.08 SEQUENCING AND SCHEDULING

- A. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying work of other trades whose work must follow erection of trusses.

### PART 2 - PRODUCTS

#### 2.01 CONNECTOR PLATE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering metal connector plates which may be incorporated in the work include, but are not limited to, the following:

1. Alpine Engineered Products, Inc.
2. Gang Nail Systems, Inc.
3. Inter-Lock Steel Co., Inc.
4. Metal Lock, Inc.
5. TEE-Lok Corp.

## 2.02 LUMBER

- A. Factory mark each piece of lumber with type, grade, mill and grading agency.
- B. Lumber Standard: Manufacture lumber to comply 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. Nominal sizes are indicated, except as shown by detail dimensions.
- D. Provide dressed lumber, S4S, manufactured to actual sizes required by PS 20 to comply with requirements indicated below.
  1. Moisture Content: Seasoned, with 19 percent maximum moisture content at time of dressing and shipment for sizes two inches or less in nominal thickness, unless otherwise indicated.
  2. Grade for Chord and Web Members: "No. 2" or better.
  3. Species: Any softwood species of specified grade.

## 2.03 METAL, CONNECTOR PLATES, FASTENERS AND ANCHORAGES

- A. General: Fabricate connector plates from metal complying with the following requirements:
  1. Hot-Dip Galvanized Steel Sheet: Structural (physical) quality steel sheet complying with ASTM A 446, Grade A; zinc coated by hot dip process to comply with ASTM A 525, Designation G60; minimum coated metal thickness indicated but not less than 0.036".
  2. Electrolytic Zinc-Coated Steel Sheet: Structural (physical) quality steel sheet complying with ASTM A 591, Coating Class C, and, for structural properties, with ASTM A 446, Grade A; zinc-coated by electro-deposition; with minimum coated metal thickness indicated but not less than 0.047".

## 2.04 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  1. Where truss members are exposed to weather or to high relative humidities, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of AISI Type 304 stainless steel
  2. Nails, Wire, Brades, and Staples: FS FF-N-105.
  3. Power Driven Fasteners: National Evaluation Report NER-272.
  4. Wood Screws: ANSI B18.6.1.
  5. Lag Bolts: ANSI B18.2.1.
  6. Bolts: Steel Bolts complying with ASTM A 307, Grade A, with hex nuts and flat washers.

## 2.05 METAL FRAMING ANCHORS

- A. General: Provide metal framing anchors of type, size, metal, and finish indicated that comply with requirements specified including the following:
  - 1. Allowable Design Loads: Provide products for which manufacturer publishes allowable design loads that are determined from empirical data or by rational engineering analysis and that are demonstrated by comprehensive testing performed by a qualified independent testing laboratory.
- B. Galvanized Sheet Steel: Steel sheet zinc-coated by hot dip process on continuous lines prior to fabrication to comply with ASTM A 525 for coating designation G 60 and with ASTM A 446, Grade A (structural quality); ASTM A 526 (Commercial Quality); or ASTM A 527 (lock forming quality); as standard with manufacturer for type of anchor indicated.

## 2.06 FABRICATION

- A. Cut truss members to accurate lengths, angles and sizes to produce close fitting joints with wood-to-wood bearing in assembled units.
- B. Fabricate metal connector plates to size, configuration, thickness and anchorage details required for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances specified in TPI "Quality Standard for Metal Plate Connected Wood Trusses". Position members to produce design camber indicated.
- D. Connect truss members by means of metal connector plates accurately located and securely fastened to each side of wood members by means indicated or approved.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. General: Erect and brace trusses to comply with applicable requirements of referenced TPI Standards.
- B. Where trusses do not fit, return them to fabricator and replace with trusses of correct size; do not alter trusses in field.
- C. Erect trusses with plane of truss webs vertical (plumb) and parallel to each other, located accurately at design spacings indicated.
- D. Hoist units in place by means of lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- E. Anchor trusses securely at all bearing points to comply with methods and details indicated.
- F. Install permanent bracing and related components to enable trusses to maintain design spacing, withstand live and dead loads including lateral loads, and to comply with other indicated requirements.
- G. Do not cut or remove truss members.

END OF SECTION 06192

SECTION 062023 - INTERIOR  
FINISH CARPENTRY

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim, including non-fire-rated interior door and sidelight frames.
2. Shelving and clothes rods.

1.2 DEFINITIONS

- A. MDF: Medium-density fiberboard.
- B. MDO: Plywood with a medium-density overlay on the face.
- C. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
- B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.
  1. Factory mark each piece of lumber with grade stamp of grading agency.
  2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.
- B. Softwood Plywood: DOC PS 1.
- C. Hardboard: ANSI A135.4.
- D. MDF: ANSI A208.2, Grade 130.
- E. Particleboard: ANSI A208.1, Grade M-2.

SECTION 062023 - INTERIOR  
FINISH CARPENTRY

- F. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper and complying with NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

1. Color: As selected by Architect from manufacturer's full range .

2.2 INTERIOR TRIM

- A. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: Red oak White maple Alder Aspen, basswood, cottonwood, sap gum, sycamore, white maple, or yellow poplar ; NHLA Clear .
2. Maximum Moisture Content: 10 percent.
3. Finger Jointing: Not allowed.
4. Gluing for Width: Allowed Use for lumber trim wider than 6 inches .
5. Veneered Material: Allowed Use for lumber trim wider than 6 inches .
6. Face Surface: Surfaced (smooth) .
7. Matching: Selected for compatible grain and color.

- B. Lumber Trim for Opaque Finish (Painted Finish):

1. Species and Grade: Yellow Poplar .
2. Maximum Moisture Content: 10 percent.
3. Finger Jointing: Not allowed.
4. Face Surface: Surfaced (smooth) .
5. Optional Material: Primed MDF of same actual dimensions as lumber indicated may be used in lieu of lumber.

- C. Moldings for Opaque Finish (Painted Finish): Made to patterns included in MMPA's "WM/Series Softwood Moulding Patterns."

1. Optional Material: Primed MDF.
2. Base Pattern: See Trim Profile Schedule base on drawings.
3. Shoe-Mold Pattern: Trim Profile Schedule shoe mold on drawings.
4. Casing Pattern: Trim Profile Schedule casings on drawings.

2.3 SHELVING AND CLOTHES RODS

- A. Closet Utility Shelving: Made from the following material , 3/4 inch thick:

1. MDO softwood plywood with solid-wood edge.
2. Melamine-faced particleboard with applied-PVC front edge.

- B. Shelf Cleats: 3/4-by-5-1/2-inch boards with hole and notch to receive clothes rods, as specified above for shelving lumber trim for opaque finish .

- C. Shelf Brackets with Rod Support: BHMA A156.16, B04051; prime-painted formed steel.

SECTION 062023 - INTERIOR  
FINISH CARPENTRY

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. A&M Hardware, Inc.
  - b. EPCO, Engineered Products Co.
  - c. Knape & Vogt Manufacturing Company.
- D. Shelf Brackets without Rod Support: BHMA A156.16, B04041; prime-painted formed steel.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. A&M Hardware, Inc.
    - b. EPCO, Engineered Products Co.
    - c. Knape & Vogt Manufacturing Company.
- E. Clothes Rods: 1-1/2-inch- diameter, clear, kiln-dried .
- F. Clothes Rods: 1-5/16-inch- diameter, chrome-plated-steel tubes .
- G. Rod Flanges: Chrome-plated steel .

2.4 MISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
- B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
- C. Paneling Adhesive: Comply with paneling manufacturer's written instructions for adhesives.
- D. Multipurpose Construction Adhesive: Formulation, complying with ASTM D 3498, that is recommended for indicated use by adhesive manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

SECTION 062023 - INTERIOR  
FINISH CARPENTRY

3.2 INSTALLATION, GENERAL

- A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.
1. Use concealed shims where necessary for alignment.
  2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
  3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
  4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
  5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.3 STANDING AND RUNNING TRIM INSTALLATION

- A. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available.
1. Do not use pieces less than 24 inches long, except where necessary.
  2. Stagger joints in adjacent and related standing and running trim.
  3. Cope at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
  4. Use scarf joints for end-to-end joints.
  5. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
  6. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
  7. Install trim after gypsum-board joint finishing operations are completed.
  8. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting.
  9. Fasten to prevent movement or warping.
  10. Countersink fastener heads on exposed carpentry work and fill holes.

3.4 PANELING INSTALLATION

- A. Plywood Paneling: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels.
1. Leave 1/4-inch gap to be covered with trim at top, bottom, and openings.
  2. Install with uniform tight joints between panels.
  3. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners.
  4. Space fasteners and adhesive as recommended by panel manufacturer.
  5. Conceal fasteners to greatest practical extent.
  6. Arrange panels with grooves and joints over supports.

SECTION 062023 - INTERIOR  
FINISH CARPENTRY

- a. Fasten to supports with nails of type and at spacing recommended by panel manufacturer.
  - b. Use fasteners with prefinished heads matching groove color.
- B. Hardboard Paneling: Install according to manufacturer's written instructions.
1. Leave 1/4-inch gap to be covered with trim at top, bottom, and openings.
  2. Butt adjacent panels with moderate contact.
  3. Use fasteners with prefinished heads matching paneling color.
  4. Wood Stud or Furring Substrate: Install with 1-inch annular-ring shank hardboard nails.
  5. Plaster or Gypsum-Board Substrate: Install with 1-5/8-inch annular-ring shank hardboard nails.
  6. Nailing: Space nails 4 inches o.c. at panel perimeter and 8 inches o.c. at intermediate supports unless otherwise required by manufacturer.

3.5 SHELVING AND CLOTHES ROD INSTALLATION

- A. Cut shelf cleats at ends of shelves about 1/2 inch less than width of shelves and sand exposed ends smooth.
1. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled.
  2. Space fasteners not more than 16 inches o.c. Use two fasteners at each framing member or fastener location for cleats 4 inches nominal in width and wider.
  3. Apply a bead of multipurpose construction adhesive to back of shelf cleats before installing.
  4. Remove adhesive that is squeezed out after fastening shelf cleats in place.
- B. Install shelf brackets according to manufacturer's written instructions, spaced not more than 32 inches o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
- C. Install standards for adjustable shelf supports according to manufacturer's written instructions. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Space fasteners not more than 12 inches o.c.
- D. Install standards for adjustable shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches o.c. and within 6 inches of ends of shelves. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
- E. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled.
1. Install shelves, fully seated on cleats, brackets, and supports.
  2. Fasten shelves to cleats with finish nails or trim screws, set flush.
  3. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.
- F. Install rod flanges for rods as indicated.

SECTION 062023 - INTERIOR  
FINISH CARPENTRY

1. Fasten to shelf cleats, framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
2. Install rods in rod flanges.

END OF SECTION 062023

**SECTION 066500 –  
Plastic Simulated Wood  
Exterior Trim**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Cellular PVC trim boards for:
  - 1. Corner boards
  - 3. Fascia
  - 4. Frieze boards
  - 5. Door trim
  - 6. Porch Ceilings

**1.2 RELATED SECTIONS**

- A. Section 09 90 00 – Painting and Coating

**SECTION 066500 –  
Plastic Simulated Wood Exterior  
Trim**

**1.3 REFERENCES**

- A. ASTM D792 - Density and Specific Gravity of Plastics by Displacement.
- B. ASTM D570 - Water Absorption of Plastics.
- C. ASTM D638 - Tensile Properties of Plastics.
- D. ASTM D790 - Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- E. ASTM D1761 - Mechanical Fasteners in Wood.
- F. ASTM D5420 - Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by means of a Striker Impacted by a Falling Weight.
- G. ASTM D256 - Determining the Pendulum Impact Resistance of Plastics.
- H. ASTM D696 - Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with a Vitreous Silica Dilatometer.
- I. ASTM D635 - Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- J. ASTM E84 - Surface Burning Characteristics of Building Materials.
- K. ASTM D648 - Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
- L. ASTM D3679 - Standard Specification for Rigid Poly Vinyl Chloride (PVC) Siding.

**1.4 SUBMITTALS**

- A. General: Submit under provisions of Section 01 30 00 – Administrative Requirements.
- 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 instructions and methods.
  - 4. Code compliance reports.

**1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Manufacturer with a minimum of 15 years producing PVC trim products.
- B. Installer Qualifications: Installer with a minimum of 3 years experience with the installation of PVC trim products.
- C. Regulatory Requirements: Check with Local Building Code for installation requirements.
- D. Allowable Tolerances:
  - 1. Variation in component length: -0.00 / +1.00"
  - 2. Variation in component width: ± 1/16"

**SECTION 066500 –  
Plastic Simulated Wood Exterior  
Trim**

3. Variation in component thickness:  $\pm 1/16''$
4. Variation in component edge cut:  $\pm 2^\circ$
5. Variation in Density -0% + 10%

**1.6 DELIVERY, STORAGE AND HANDLING**

- A. Trim materials should be stored on a flat and level surface on a full shipping pallet. Handle materials to prevent damage to product edges and corners.
- B. Store materials under a protective covering to prevent jobsite dirt and residue from collecting on the boards.

**1.7 WARRANTY**

- A. Provide manufacturer’s Limited Lifetime warranty against defects in manufacturing that cause the products to rot, corrode, delaminate, or excessively swell from moisture.

**PART II PRODUCTS**

**2.1 MANUFACTURES**

- A. Acceptable products: AZEK® Trimboards manufactured by The AZEK® Company, which is located at: 888 N Keyser Ave Scranton, PA 18508
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 – Product Requirements

**2.2 MATERIALS**

- A. PVC: Free foam cellular PVC material with a small cell microstructure and density of .55 grams/cm<sup>3</sup>.
  - Material shall have a minimum physical and performance properties specified in the following Section C.
- C. Performance and physical characteristic requirements:

Property	Units	Value	ASTM Method
<b>PHYSICAL</b>			
Density	g/cm <sup>3</sup>	0.55	D 792
Water Absorption	%	0.15	D 570
<b>MECHANICAL</b>			
Tensile Strength	psi	2256	D 638
Tensile Modulus	psi	144,000	D 638
Flexural Strength	psi	3329	D 790
Flexural Modulus	psi	144,219	D 790
Nail Hold	Lbf/in of penetration	35	D 1761

**SECTION 066500 –  
Plastic Simulated Wood Exterior  
Trim**

Property	Units Lbf/in of penetration	Value	ASTM Method
Screw Hold	Lbf/in of penetration	680	D 1761
Staple Hold	Lbf/in of penetration	180	D 1761
Gardner Impact	in-lbs	103	D5420
Charpy Impact (@23°C)	ft-lbs	4.5	D256
<b>THERMAL</b>			
Coefficient of Linear Expansion	in/in/°F	3.2 x 10-5	D 696
Burning Rate	in/min	No burn when flame removed	D 635
Flame Spread Index	--	25	E 84
Heat Deflection Temp 264 psi	°F	150	D 648
Oil Canning (@140°F)	°F	Passed	D 648

**2.3 SIMULATED WOOD TRIM**

A. PVC Trimboard: AZEK® Trimboard with Sealed Edge, designed with a natural appearance to compliment fiber cement and natural cedar.

1. Size:
  - a. See Drawings
2. Finish:
  - a. Traditional/Smooth finish

C. PVC Cornerboard: AZEK® Corners: Folded, 90-degree, one-piece assembly produced with a Traditional or Frontier appearance to compliment fiber cement and natural cedar.

1. Size:
  - a. Nominal Corner Size:
    - 1) 4 inches
    - 2) 6 inches
    - 3) 8 inches
  - b. Nominal Thickness:
    - 1) 5/4 inch (1 inch actual size)
  - c. Length:
    - 1) 10 feet
    - 2) 20 feet
2. Finish:
  - a. Traditional (Smooth)
  - b. Frontier (Woodgrain)

D. PVC Bead Board: AZEK® Beadboard: Tongue-and-Groove and Beaded Sheets.

1. Size:
  - a. See Drawings
2. Finish:
  - a. Traditional/Smooth finish.

**SECTION 066500 –  
Plastic Simulated Wood Exterior  
Trim**

- E. Mouldings: AZEK® Mouldings designed to complement exterior trim.
1. Crowns:  
See Drawings

**2.5 SIMULATED WOOD TRIM**

- A. Paintable PVC Trimboard: AZEK® PaintPro® Trimboard, designed with a natural appearance to compliment fiber cement, engineered wood, natural cedar and is engineered to be painted.
9. Size:
    - a. See Drawings
    - c. Length:
      - 1) 16 feet
  10. Finish:
    - a. Reversible with Traditional (Smooth)/Frontier (Woodgrain) finish
    - b. Painting
      - 1) Must be painted within 180 days of UV exposure
      - 2) For lighter colors with a Light Reflective Value (LRV) 55 or greater: paint must be 100% acrylic latex.
      - 3) For darker colors with an LRV less than 55: Paint must be vinyl-safe from a vinyl-safe color palette.
      - 4) For custom color, use a coating with solar reflective pigments

**2.6 ACCESSORY PRODUCTS**

- A. Fasteners:
1. AZEK® Cortex for Trim
  2. Use fasteners design for wood trim and wood siding (thinner shank, blunt point, full round head) with AZEK®.
  3. Use a highly durable fastener such as stainless steel or hot-dipped galvanized.
  4. Staples, small brads and wire nails must not be used as fastening members.
  5. The fasteners should be long enough to penetrate the solid wood substrate a minimum of 1 ½”.
  6. Standard nail guns work well with AZEK® trim products.
  7. Use 2 fasteners per every framing member for trimboard applications. Trimboards 12” or wider, as well as sheets, will require additional fasteners.
  8. Fasteners must be installed no more than 2” from the end of each board.
  9. AZEK® should be fastened into a flat, solid substrate. Fastening AZEK® into hollow or uneven areas must be avoided.
  10. Pre-drilling is typically not required unless a large fastener is used or product is installed in low temperatures.
  11. 3/8” and ½” sheet product is not intended to be ripped into trim pieces. These profiles must be glued to a substrate and mechanically fastened.
- B. Adhesives:

**SECTION 066500 –  
Plastic Simulated Wood Exterior  
Trim**

1. Glue all AZEK® to AZEK® joints such as window surrounds, long fascia runs, etc. with AZEK® Adhesive, a cellular pvc cement, to prevent joint separation.
2. The glue joint should be secured with a fastener and/or fastened on each side of the joint to allow adequate bonding time.
3. AZEK® Adhesive has a working time of 10 minutes and will be fully cured in 24 hours.
4. If standard pvc cements are used, keep in mind these products typically cure quickly which will result in limited working time and may reduce adhesive strength.
5. Surfaces to be glued should be smooth, clean and in complete contact with each other.
6. To bond AZEK® to other substrates, various adhesives may be used. Consult adhesive manufacturer to determine suitability.

C. Sealants:

1. Use urethane, polyurethane or acrylic based sealants without silicone.

## 2.7 FINISHES

A. AZEK products do not require paint for protection but may be painted to achieve a custom color.

B. Preparation:

1. No special surface preparations are required prior to painting - sanding is not necessary for paint adhesion.
2. Surface must be clean and dry.
3. Use a 100% acrylic latex paint with a Light Reflective Value (LRV) of 55 or higher.
4. Follow the paint manufacturer's recommendations to apply.

## PART III EXECUTION

### 3.01 INSTALLATION

A. Manufacturer instructions:

1. Comply with manufacturer's product catalog installation instructions and product technical bulletin instructions.

B. Cutting:

1. AZEK® products can be cut using the same tools used to cut lumber.
2. Carbide tipped blades designed to cut wood work well. Avoid fine tooth metal cutting blades.
3. Rough edges from cutting may be caused by excessive friction, poor board support, or worn or improper tooling.

C. Cutting:

1. AZEK® products can be drilled using the same tools used to drill lumber.
2. Drilling AZEK® products is similar to drilling a hardwood. Care should be taken to avoid frictional heat build-up.
3. Use standard woodworking drills. Do not use drills made for normal rigid pvc.
4. Periodic removal of AZEK® shavings from the drill hole may be necessary.

D. Milling:

1. AZEK® products can be milled using standard milling machines used to mill lumber.
2. Relief Angle 20° to 30°

**SECTION 066500 –  
Plastic Simulated Wood Exterior  
Trim**

3. Cutting speed to be optimized with the number of knives and feed rate.
- E. Routing:
1. AZEK® products can be routed using standard router bits and the same tools used to rout lumber.
  2. Carbide tipped router bits are recommended.

**SECTION 066500 –  
Plastic Simulated Wood  
Exterior Trim**

F. Edge Finishing:

1. Edges can be finished by sanding, grinding or filing with traditional woodworking tools.

G. Nail Location:

1. Use 2 fasteners per every framing member for trimboard applications.
2. Trimboards over 12" or wider, as well as sheets, will require additional fasteners.
3. Fasteners must be installed no more than 2" from the end of each board.

H. Thermal Expansion and Contraction:

1. AZEK® products expand and contract with changes in temperature.
2. Properly fastening AZEK® material along its entire length will minimize expansion and contraction.
3. When properly fastened, allow 1/8" per 18 foot of AZEK® product for expansion and contraction.
4. Joints between pieces of AZEK® should be glued to eliminate joint separation. When gaps are glued on a long run of AZEK®, allow expansion and contraction at ends of the run.

END OF SECTION

SECTION 070150.19 -  
PREPARATION FOR  
REROOFING

SECTION 070150.19 - PREPARATION FOR REROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Full tear-off of entire roof system .
2. Re-cover preparation of entire roof area .
3. Removal of flashings and counterflashings.

1.2 INFORMATIONAL SUBMITTALS

1.3 QUALITY ASSURANCE

1.4 FIELD CONDITIONS

- A. Existing Roofing System: <Insert roof type> roofing.
- B. Owner will not occupy portions of building immediately below reroofing area.
1. Conduct reroofing so Owner's operations are not disrupted.
- C. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.
- D. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
- E. Limit construction loads on existing roof areas to remain, and existing roof areas scheduled to be reroofed to for rooftop equipment wheel loads and for uniformly distributed loads.
- F. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.
1. Remove only as much roofing in one day as can be made watertight in the same day.

1.5 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during reroofing, by methods and with materials so as not to void existing roofing system warranty issued by .

SECTION 070150.19 -  
PREPARATION FOR  
REROOFING

PART 2 - PRODUCTS

2.1 AUXILIARY REROOFING MATERIALS

- A. General: Use auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of new roofing system.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Seal or isolate windows that may be exposed to airborne substances created in removal of existing materials.
- B. Shut off rooftop utilities and service piping before beginning the Work.
- C. Test existing roof drains to verify that they are not blocked or restricted.
  - 1. Immediately notify Architect of any blockages or restrictions.
- D. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work.
  - 1. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.
- E. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.
- F. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday.
  - 1. Prevent debris from entering or blocking roof drains and conductors.
    - a. Use roof-drain plugs specifically designed for this purpose.
    - b. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
  - 2. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding.
    - a. Do not permit water to enter into or under existing roofing system components that are to remain.

3.2 ROOF TEAR-OFF

- A. Lower removed roofing materials to ground and onto lower roof levels, using dust-tight chutes or other acceptable means of removing materials from roof areas.
- B. Remove pavers and accessories from roofing.

SECTION 070150.19 -  
PREPARATION FOR  
REROOFING

1. Store and protect pavers and accessories for reuse in manner not to exceed structural loading limitations of roof deck.
  2. Discard cracked pavers.
- C. Full Roof Tear-off: Remove existing roofing and other roofing system components down to the existing roof deck .
1. Remove vapor retarder .
  2. Remove base flashings and counter flashings.
  3. Remove perimeter edge flashing and gravel stops.
  4. Remove copings.
  5. Remove flashings at pipes, curbs, mechanical equipment, and other penetrations.
  6. Remove roof drains indicated on Drawings to be removed.
  7. Remove wood blocking, curbs, and nailers.
  8. Remove fasteners from deck.

3.3 DECK PREPARATION

- A. Inspect deck after tear-off of roofing system.
- B. If broken or loose fasteners that secure deck panels to one another or to structure are observed, or if deck appears or feels inadequately attached, immediately notify Architect.
1. Do not proceed with installation until directed by Architect.
- C. If deck surface is unsuitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect.
1. Do not proceed with installation until directed by Architect.
- D. Provide additional deck securement as indicated on Drawings.
- E. Replace plywood roof sheathing as indicated on Drawings.
- F. Replace plywood roof sheathing as directed by Architect.
1. Roof sheathing replacement will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

3.4 ROOF RE-COVER PREPARATION

- A. Remove blisters, ridges, buckles, and other substrate irregularities from existing roofing that inhibit new recover boards from conforming to substrate.
1. Remove loose aggregate from aggregate-surfaced, built-up bituminous roofing with a power broom.
  2. Broom clean existing substrate.
  3. Coordinate with Owner's inspector to schedule times for tests and inspections.

SECTION 070150.19 -  
PREPARATION FOR  
REROOFING

4. Verify that existing substrate is dry.
    - a. Spot check substrates with an electrical capacitance moisture-detection meter.
  5. Remove materials that are wet or damp.
    - a. Removal will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.
- B. Remove blisters, ridges, buckles, and other substrate irregularities from existing roofing that inhibit new roofing from conforming to substrate.
1. Broom clean existing substrate.
  2. Coordinate with Owner's inspector to schedule times for tests and inspections.
  3. Verify that existing substrate is dry before proceeding with installation.
    - a. Spot check substrates with an electrical capacitance moisture-detection meter.
  4. Remove materials that are wet and damp.
    - a. Removal will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

3.5 BASE FLASHING REMOVAL

- A. Remove existing base flashings.
1. Clean substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.
- B. Do not damage metal counterflashings that are to remain.
1. Replace metal counterflashings damaged during removal with counterflashings specified in Section 076200 "Sheet Metal Flashing and Trim."
- C. When directed by Architect, replace parapet framing, wood blocking, curbs, and nailers to comply with Section 061000 "Rough Carpentry."

END OF SECTION 070150.19

## SECTION 071000 – FOUNDATION DAMPPROOFING & WATERPROFFING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Below grade waterproofing and dampproofing

#### 1.2 RELATED SECTIONS

#### 1.3 REFERENCES

- A. AATC 127 - Water Resistance: Hydrostatic Pressure Test; 1998.
- B. ASTM C 1311 - Standard Specification for Solvent Release Sealants; 2002.
- C. ASTM D 1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics; 2004a.
- D. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.
- E. CCMC Technical Guide for Foundation Wall Drainage Systems – Dimpled Membranes. Master Format Section 02622.1; (Oct. 11, 2006).
- F. CCMC Technical Guide for Rigid Polyethylene or Polystyrene Dampproofing Membrane. Master Format Section 07111; (Oct. 11, 2001).
- G. CGSB 19-GP-14M - Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing; 1984.
- R. ICC-ES – Evaluation Guidelines for Rigid Polyethylene Below Grade, Dampproofing and Wall Waterproofing Material EG 114; (Mar. 1, 2004)

#### 1.4 SUBMITTALS

- A. See Section 01300 - 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.
  - 4. Specimen warranty.
- C. Samples: 12 by 12 inch (300 by 300 mm) piece of sheet; minimum 12 inch (300 mm) long piece of strip; each type of fastener.
- D. Test Reports: Evaluation service reports or other independent testing agency reports showing compliance with specified requirements.
- E. Installer Qualifications: Include minimum of 5 project references.
- F. Executed warranty.

#### 1.5 QUALITY ASSURANCE

## SECTION 071000 – FOUNDATION DAMPPROOFING & WATERPROFFING

- A. Installer Qualifications: Company specializing in performing work of this type and approved by the membrane manufacturer.
- B. Manufacturer's Field Services: Provide the services of a representative accredited by the sheet manufacturer to examine substrates before starting installation, periodically review installation procedures, and review final installed systems.

### 1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver products to project site in original packaging with labels intact.
- B. Store products in manner acceptable to membrane manufacturer.
- C. When products must be stored for extended periods, keep out of direct sunlight and at temperatures above minus 22 degrees F (minus 30 degrees C).
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

### 1.7 WARRANTY

- A. Manufacturer's Limited Product Warranty.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. All Products of This Section:
  - 1. Dörken Systems Inc: [www.dorken.com](http://www.dorken.com)
  - 2. Substitutions: See Section 01600 - Product Requirements

### 2.2 APPLICATIONS

- A. Foundation Wall Waterproofing or dampproofing: Install membrane to all walls below grade, from bottom of wall to grade level, and in locations indicated on the drawings.

### 2.3 MATERIALS

- A. Foundation Wall Waterproofing or dampproofing Membrane: High density polyethylene sheet, dimpled throughout field of sheet, with flat flanges on manufactured edges.
  - 1.
    - a. Product: Dörken Systems Inc. DELTA®-MS
    - b. Color: Brown.
    - c. Working Temperature Range: Minus 22° F (minus 30° C) to 176° F (80° C).
    - d. Dimple Height: 5/16 inch (8mm)
    - e. Compressive Strength: ASTM D 1621: Approximately 5200 psf (250 kN/sq m)
    - f. Flange Width: 2 inch (50 mm)
    - g. UV Stability: 30 days maximum UV exposure, however cover as soon as possible
    - h. Material Quality: Meeting minimum requirements of CCMC Technical Guide for Rigid Polyethylene or Polystyrene Dampproofing Membrane.
    - i. Sheet Width: As required to result in as few seams as possible.
    - j. Recycled Content: 60% post consumer / post-industrial HDPE
    - k. Sustainable Design: Virgin co-extrusion process, utilizing virgin polyethylene on the outside layers and recycled HDPE in the middle to provide long-term in situ performance.
- B. Accessories as recommended by product manufacturer's installation instructions.

## SECTION 071000 – FOUNDATION DAMPPROOFING & WATERPROFFING

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that substrates are sound enough to retain fasteners and suitable for bonding of sealant.
- B. Verify that there are no active leaks within area to be covered.
- C. Verify that perimeter foundation drainage system has been properly installed.
- D. Verify that finish grade elevations are clearly marked.
- E. Do not begin installation until substrates have been properly prepared.
- F. If substrate preparation is the responsibility of another trade, notify Architect of unsatisfactory preparation before proceeding.

#### 3.2 PREPARATION

- A. Clean surfaces "broom clean" 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.
  - 1. Remove projections larger than 1/4 inch (6 mm); remove sharp edges.
  - 2. In concrete and masonry, patch cracks and holes so that they provide suitable substrate as recommended by membrane manufacturer.
- C. Mark a chalk line at anticipated grade level on walls prior to starting installation.

#### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's recommended procedure.
- B. Do not install when:
  - 1. Ambient temperature is below minus 22 degrees F (minus 30 degrees C).
  - 2. Concrete has been cured for less than 3 days.
  - 3. Standing water is present.
- C. General Sheet Installation: Start at lowest point and work to top, running length of sheets horizontally and overlapping upper sheets in shingle fashion at least 6 inches (150 mm); lap vertical joints at least 6 inches (150 mm).
  - 1. Install sheets without gaps, wrinkles, creases, or tears.
  - 2. Align and interlock overlapping layers.
  - 3. Secure to substrate at edges and in the field of the sheet using fasteners and methods recommended by sheet manufacturer; stagger fasteners in alternate rows.
  - 4. Flash and seal top edges, around openings and penetrations, and other locations recommended by manufacturer, in manner recommended by manufacturer.
- D. Foundation wall waterproofing or dampproofing: In addition to general sheet installation specified above:

## SECTION 071000 – FOUNDATION DAMPPROOFING & WATERPROFFING

1. Install with protruding dimples on side facing substrate.
  2. Unless otherwise indicated, fasten dimpled sheets using specified fasteners with dimpled washers interlocked with sheet at not more than 24 inches (600 mm) on center in a “W” pattern.
  3. At top, install with flat edge secured with DELTA<sup>®</sup>-MOLD STRIP. Fasten at not more than 8 inches (200 mm) on center.
  4. At all joints, apply continuous bead of sealant between layers and fasten through both layers with specified fasteners with dimpled washers.
  5. At vertical joints, overlap sheets at least 6 inches (150 mm) and interlock dimples, making full contact with sealant.
  6. At horizontal joints, apply continuous sealant bead between wall and top flange of lower sheet and fasten lower sheet along top edge; overlap upper sheet over flat flange of lower sheet and fasten through both sheets at lower edge of upper sheet at 36” (910 mm) on center.
  7. At interruptions and penetrations, apply continuous bead of sealant between sheet and substrate, fasten sheet around entire opening at not more than 8 inches (100 mm) on center, and cover cut edge with flashing strip sealed to wall and fastened at not more than 8 inches (100 mm) on center.
  8. At inside and outside corners, install sheet as close to substrate as possible without breaking and fasten along both sides entire length of corner, not closer than 5 inches (125 mm) to corner.
  9. At bottom of walls, extend a single sheet from wall over footing to drainage pipe.
- E. Repairs to Dimpled Sheet: Apply patch made of same material interlocked, with continuous sealant bead around tear or penetration.

### 3.4 FIELD QUALITY CONTROL

- A. Provide the services of a manufacturer's representative to inspect substrates for suitability for installation, to review procedures during construction, and to review the finished work.

### 3.5 PROTECTION

- A. Do not leave installed membrane exposed to sunlight for more than 30 days after installation; to cover, complete backfill operation or cover with protection board.
- B. Prior to backfilling, inspect DELTA<sup>®</sup>-MS for tears and other damage and repair.
- C. Take care when backfilling to avoid damage to membrane; replace membrane damaged during backfilling.
- D. Protect installed products until completion of project.
- E. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 072100 - THERMAL  
INSULATION

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Glass-fiber blanket insulation.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
1. Extruded polystyrene foam-plastic board insulation.
  2. Glass-fiber blanket insulation.

1.3 INFORMATIONAL SUBMITTALS

- A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.
1. Sign, date, and post the certification in a conspicuous location on Project site.
- B. Product test reports.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

- A. Glass-Fiber Blanket Insulation, Unfaced : ASTM C665, Type I; passing ASTM E136 for combustion characteristics.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corporation.
    - b. CertainTeed Insulation.
    - c. Johns Manville; a Berkshire Hathaway company.
    - d. Knauf Insulation.
    - e. Owens Corning.
  2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
  3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
  4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

SECTION 072100 - THERMAL  
INSULATION

2.2 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
  - 1. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
- B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.2 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
  - 1. If not otherwise indicated, extend insulation a minimum of 36 inches 48 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
  - 1. If not otherwise indicated, extend insulation a minimum of 36 inches 48 inches in from exterior walls.

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

SECTION 072100 - THERMAL  
INSULATION

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
  4. For wood-framed construction, install blankets according to ASTM C1320 and as follows:
    - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
  2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

END OF SECTION 072100

SECTION 072119 - FOAMED-  
IN-PLACE INSULATION

SECTION 072119 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Closed-cell spray polyurethane foam.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

A. Closed-Cell Spray Polyurethane Foam: ASTM C1029, Type II, minimum density of 1.5 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Carlisle Spray Foam Insulation.
  - b. Gaco Western LLC.
  - c. Henry Company.
  - d. HUNTSMAN BUILDING SOLUTIONS (formerly Demilec, Icynene, Lapolla).
  - e. Icynene-Lapolla; Icynene.
  - f. Johns Manville; a Berkshire Hathaway company.
  - g. Master Builders Solutions.
2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - a. Flame-Spread Index: 25 or less.
  - b. Smoke-Developed Index: 450 or less.
3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

SECTION 072119 - FOAMED-  
IN-PLACE INSULATION

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Spray insulation to envelop entire area to be insulated and fill voids.
- C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

END OF SECTION 072119

SECTION 073113 - ASPHALT  
SHINGLES

SECTION 073113 - ASPHALT SHINGLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber-reinforced asphalt shingles.
2. Underlayment materials.
3. Metal flashing and trim.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Asphalt shingles.
2. Underlayment materials.
3. Ridge vents.
4. Asphalt roofing cement.
5. Elastomeric flashing sealant.

- B. Samples: For each exposed product and for each color and blend specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized installer who is trained and approved by manufacturer.

1.7 WARRANTY

- A. Materials Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.

SECTION 073113 - ASPHALT  
SHINGLES

1. Materials Warranty Period: 30 years from date of Substantial Completion, prorated, with first seven 5 years nonprorated.
2. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to 130 mph for 15 years from date of Substantial Completion.
3. Algae-Resistance Warranty Period: Asphalt shingles will not discolor for 20 years from date of Substantial Completion.
4. Workmanship Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Exterior Fire-Test Exposure: Provide asphalt shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance in accordance with ASTM E108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
- B. Wind Resistance: Provide asphalt shingles that comply with requirements of ASTM D3161/D3161M, Class F, and with ASTM D7158/D7158M, Class H.

2.2 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

- A. Laminated-Strip Asphalt Shingles: ASTM D3462/D3462M, laminated, multi-ply overlay construction; glass-fiber reinforced, mineral-granule surfaced, and self-sealing.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed LLC; Saint-Gobain North America.
    - b. GAF.
    - c. Owens Corning.
  2. Strip Size: Manufacturer's standard .
  3. Algae Resistance: Granules resist algae discoloration.
  4. Color and Blends: As selected by Architect from manufacturer's full range .
- B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles .

2.3 UNDERLAYMENT MATERIALS

- A. Synthetic Underlayment: UV-resistant polypropylene, polyolefin, or polyethylene polymer fabric with surface coatings or treatments to improve traction underfoot and abrasion resistance; evaluated and documented to be suitable for use as a roof underlayment under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ALCO Products LLC.
    - b. Atlas Polyiso Roof and Wall Insulation.

SECTION 073113 - ASPHALT  
SHINGLES

- c. Building Products of Canada Corp.
- d. Certainteed; SAINT-GOBAIN.
- e. Drexel Metals.
- f. G.A.P. Roofing, Inc.
- g. GAF.
- h. GCP Applied Technologies Inc.
- i. IKO Industries Inc.
- j. Malarkey Roofing Products.
- k. Owens Corning.
- l. SDP Advanced Polymer Products Inc.
- m. SystemComponents Corporation.
- n. Tamko Building Products LLC.

B. Self-Adhering, Polymer-Modified Bitumen Sheet: ASTM D1970/D1970M, minimum 50-mil-thick sheet; glass-fiber-mat-reinforced, polymer-modified asphalt; with slip-resistant top surface and release backing; cold applied.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ALCO Products LLC.
  - b. Atlas Molded Products, a division of Atlas Roofing Corporation.
  - c. Carlisle WIP Products; a brand of Carlisle Construction Materials.
  - d. Certainteed; SAINT-GOBAIN.
  - e. GAF.
  - f. Henry Company.
  - g. Malarkey Roofing Products.
- 2. Top Surface: Sand .

2.4 ACCESSORIES

- A. Asphalt Roofing Cement: ASTM D4586/D4586M Type II, asbestos free.
- B. Elastomeric Flashing Sealant: ASTM C920, Type S, Grade NS, one-part, non-sag, elastomeric polymer sealant; of class and use classifications required to seal joints and remain watertight; recommended in writing by manufacturer for installation of flashing systems.
- C. Roofing Nails: ASTM F1667, aluminum, stainless steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch- diameter, sharp-pointed, with a 3/8- to 7/16-inch-diameter flat head and of sufficient length to penetrate 3/4 inch into solid wood decking or extend at least 1/8 inch through sheathing less than 3/4 inch thick.
  - 1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.
- D. Underlayment Nails: Aluminum, stainless steel, or hot-dip galvanized-steel wire nails with low-profile metal or plastic caps, 1-inch- minimum diameter.
  - 1. Provide with minimum 0.0134-inch- thick metal cap, 0.010-inch- thick power-driven metal cap, or 0.035-inch- thick plastic cap; and with minimum 0.083-inch- thick ring

SECTION 073113 - ASPHALT  
SHINGLES

shank or 0.091-inch- thick smooth shank of length to penetrate at least 3/4 inch into roof sheathing or to penetrate through roof sheathing less than 3/4 inch thick.

2.5 METAL FLASHING AND TRIM

- A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
  - 1. Sheet Metal: Anodized aluminum Aluminum, mill finished .
- B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item unless otherwise indicated on Drawings.
  - 1. Vent-Pipe Flashings: ASTM B749, Type L51121, at least 1/16 inch thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof, and extending at least 4 inches from pipe onto roof.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT MATERIALS

- A. Comply with asphalt shingle and underlayment manufacturers' written installation instructions and with recommendations in NRCA's "The NRCA Roofing Manual: Steep-Slope Roof Systems" applicable to products and applications indicated unless more stringent requirements are specified in this Section or indicated on Drawings.
- B. Synthetic Underlayment:
  - 1. Install on roof deck parallel with and starting at the eaves.
    - a. Lap sides and ends as recommended in writing by manufacturer, but not less than 4 inches for side laps and 6 inches for end laps.
    - b. Stagger end laps between succeeding courses at interval recommended in writing by manufacturer, but not less than 72 inches.
    - c. Fasten with underlayment nails in accordance with manufacturer's written instructions.
    - d. Cover underlayment within period recommended in writing by manufacturer.
  - 2. Install in single layer on roofs sloped at 4:12 and greater.
  - 3. Install in double layer on roofs sloped at less than 4:12.
  - 4. Install fasteners in a grid pattern of 12 inches between side laps with 6-inch spacing at side and end laps.
  - 5. Terminate synthetic underlayment extended up not less than 4 inches against sidewalls, curbs, chimneys, and other roof projections.
- C. Self-Adhering, Polymer-Modified Bitumen Sheet: Install, wrinkle free, on roof deck in locations indicated on Drawings.
  - 1. Comply with low-temperature installation restrictions of underlayment manufacturer.
  - 2. Install lapped in direction that sheds water.

SECTION 073113 - ASPHALT  
SHINGLES

- a. Lap sides not less than 4 inches.
  - b. Lap ends not less than 6 inches, staggered 24 inches between succeeding courses.
  - c. Roll laps with roller.
3. Cover underlayment within seven days.

3.2 INSTALLATION OF METAL FLASHING AND TRIM

- A. Install metal flashings and trim to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
1. Install metal flashings in accordance with recommendations in ARMA's "Asphalt Roofing Residential Manual - Design and Application Methods" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
  2. Bed flanges of metal flashings using asphalt roofing cement or elastomeric flashing sealant.
- B. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.

3.3 INSTALLATION OF ASPHALT SHINGLES

- A. Install asphalt shingles in accordance with manufacturer's written instructions and recommendations in ARMA's "Asphalt Roofing Residential Manual - Design and Application Methods" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
- B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip at least 7 inches wide with self-sealing strip face up at roof edge.
1. Extend asphalt shingles 3/4 inch over fasciae at eaves and rakes.
  2. Install starter strip along rake edge.
- C. Install first and remaining courses of laminated asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- D. Install first and remaining courses of three-tab-strip asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- E. Fasten asphalt shingle strips with a minimum of four roofing nails, but not less than the number indicated in manufacturer's written instructions for roof slope and design wind speed indicated on Drawings and for warranty requirements specified in this Section.
1. Locate fasteners in accordance with manufacturer's written instructions.
  2. Where roof slope exceeds 18:12, hand seal self-sealing asphalt shingles to improve the shingles' positive bond by applying asphalt roofing cement spots between course overlaps after nailing the upper course.

SECTION 073113 - ASPHALT  
SHINGLES

3. Where roof slope is less than 4:12, hand seal self-sealing asphalt shingles to improve the shingles' positive bond by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
  4. When ambient temperature during installation is below 50 deg F , hand seal self-sealing asphalt shingles by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
- F. Closed-Cut Valleys: Extend asphalt shingle strips from one side of valley 12 inches beyond center of valley.
1. Use one-piece shingle strips without joints in valley.
  2. Fasten with extra nail in upper end of shingle. Install asphalt shingle courses from other side of valley and cut back to a straight line 2 inches short of valley centerline.
  3. Trim upper concealed corners of cut-back shingle strips.
  4. Do not nail asphalt shingles within 6 inches of valley center.
  5. Set trimmed, concealed-corner asphalt shingles in a 3-inch- wide bed of asphalt roofing cement.
- G. Hip and Ridge Shingles: Maintain same exposure of cap shingles as roofing-shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds.
1. Fasten with roofing nails of sufficient length to penetrate sheathing.
  2. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

END OF SECTION 073113

SECTION 074113.16 -  
STANDING-SEAM METAL  
ROOF PANELS

SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standing-seam metal roof panels.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of metal panel indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranties: Sample of special warranties.

1.5 CLOSEOUT SUBMITTALS

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

SECTION 074113.16 -  
STANDING-SEAM METAL  
ROOF PANELS

1. Finish Warranty Period: 30 years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
  1. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
  1. Uplift Rating: UL 90.
- B. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
  1. Fire/Windstorm Classification: Class 1A- 90 .
  2. Hail Resistance: MH SH.

2.2 STANDING-SEAM METAL ROOF PANELS

- A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
  1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.
  2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1637.
- B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels : Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AEP Span; A BlueScope Steel Company.
    - b. ATAS International, Inc.
    - c. CENTRIA.

SECTION 074113.16 -  
STANDING-SEAM METAL  
ROOF PANELS

- d. MBCI.
- e. McElroy Metal, Inc.
- f. Metal Sales Manufacturing Corporation.
- g. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
  - a. Nominal Thickness: 24 Gauge .
  - b. Exterior Finish: Two-coat fluoropolymer .
  - c. Color: As selected by Architect from manufacturer's full range .
3. Clips: One-piece fixed to accommodate thermal movement.
  - a. Material: 0.025-inch- thick, stainless-steel sheet.
4. Panel Coverage: 12 inches .
5. Panel Height: 1.0 inch .

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
  1. Thermal Stability: Stable after testing at 240 deg F; ASTM D1970.
  2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.
  3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ATAS International, Inc.
    - b. Carlisle WIP Products; a brand of Carlisle Construction Materials.
    - c. GCP Applied Technologies Inc.
    - d. Henry Company.
    - e. Owens Corning.
- B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.

SECTION 074113.16 -  
STANDING-SEAM METAL  
ROOF PANELS

2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
  2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
  3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

## 2.5 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

## 2.6 FINISHES

- A. Panels and Accessories:

SECTION 074113.16 -  
STANDING-SEAM METAL  
ROOF PANELS

1. Two-Coat Fluoropolymer: AAMA 621 AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat.
2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.2 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.
  1. Apply over the entire roof surface.
  2. Apply over the roof area indicated below:
    - a. Roof perimeter for a distance up from eaves of 24 inches beyond interior wall line.
    - b. Valleys, from lowest point to highest point, for a distance on each side of 18 inches. Overlap ends of sheets not less than 6 inches.
    - c. Rake edges for a distance of 18 inches.
    - d. Hips and ridges for a distance on each side of 12 inches.
    - e. Roof-to-wall intersections for a distance from wall of 18 inches.
    - f. Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of 18 inches.

- B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

- C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.3 INSTALLATION OF STANDING SEAM METAL ROOF PANELS

- A. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
  1. Install clips to supports with self-tapping fasteners.
  2. Install pressure plates at locations indicated in manufacturer's written installation instructions.

SECTION 074113.16 -  
STANDING-SEAM METAL  
ROOF PANELS

3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
  4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
  5. Watertight Installation:
    - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
    - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    - c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074113.16

SECTION 075323 -  
ETHYLENE-PROPYLENE-  
DIENE-MONOMER (EPDM)  
ROOFING

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered ethylene-propylene-diene-terpolymer (EPDM) roofing system.
2. Substrate board.
3. Roof insulation.
4. Cover board.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
  - a. Submit evidence of complying with performance requirements.
2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

SECTION 075323 -  
ETHYLENE-PROPYLENE-  
DIENE-MONOMER (EPDM)  
ROOFING

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 20 years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
- B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the Resistance to Foot Traffic Test in FM Approvals 4470.
- C. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
  - 1. Fire/Windstorm Classification: Class 1A-90 .
  - 2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 MH .
- D. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in SPRI's Directory of Roof Assemblies for roof assembly identical for that specified for this Project.
  - 1. Wind Uplift Load Capacity: 90 psf .
- E. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A ; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.2 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING

- A. EPDM Sheet: ASTM D4637/D4637M, Type I, nonreinforced, EPDM sheet with factory-applied seam tape.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlisle SynTec Incorporated.
    - b. Firestone Building Products.
    - c. Johns Manville; a Berkshire Hathaway company.

SECTION 075323 -  
ETHYLENE-PROPYLENE-  
DIENE-MONOMER (EPDM)  
ROOFING

2. Thickness: 60 mils , nominal.
3. Exposed Face Color: Black .

2.3 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
  1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. Protection Sheet: Epichlorohydrin or neoprene nonreinforced flexible sheet, 55 to 60 mils thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.
- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- D. Bonding Adhesive: Manufacturer's standard , water based.
- E. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch- wide minimum, butyl splice tape with release film .
- F. Lap Sealant: Manufacturer's standard, single-component sealant , colored to match membrane roofing.
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing system manufacturer.
- H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.
  1. Provide white flashing accessories for white EPDM membrane roofing.

2.4 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M, fiber-reinforced gypsum board.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Georgia-Pacific Gypsum LLC.
    - c. National Gypsum Company.
    - d. USG Corporation.
  2. Thickness: Type X, 5/8 inch.

SECTION 075323 -  
ETHYLENE-PROPYLENE-  
DIENE-MONOMER (EPDM)  
ROOFING

3. Surface Finish: Factory primed .

- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate panel to roof deck.

2.5 ROOF INSULATION

- A. Composite Polyisocyanurate Board Insulation: ASTM C1289, with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Atlas EPS; a Division of Atlas Roofing Corporation.
  - b. Atlas Roofing Corporation.
  - c. Firestone Building Products.
  - d. GAF.
  - e. Hunter Panels.
  - f. Insulfoam; Carlisle Construction Materials Company.
  - g. Johns Manville; a Berkshire Hathaway company.
2. Size: 48 by 48 inches 48 by 96 inches.
3. Thickness: 6 Inches .

- B. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation .
2. Minimum Thickness: 1/4 inch.
3. Slope:
  - a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
  - b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.6 INSULATION ACCESSORIES

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

- B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

- C. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum substrate, or ASTM C1278/C1278M, fiber-reinforced gypsum board.

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

SECTION 075323 -  
ETHYLENE-PROPYLENE-  
DIENE-MONOMER (EPDM)  
ROOFING

- a. Georgia-Pacific Gypsum LLC.
  - b. National Gypsum Company.
  - c. USG Corporation.
2. Thickness: 1/2 inch .
  3. Surface Finish: Factory primed .

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
  1. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
  2. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer when tested according to ASTM F2170.
    - a. Test Frequency: One test probe per each 1000 sq. ft. , or portion thereof, of roof deck, with not less than three test probes.
    - b. Submit test reports within 24 hours of performing tests.
  3. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
  4. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.

3.2 PREPARATION

- A. Perform fastener-pullout tests according to roof system manufacturer's written instructions.
  1. Submit test result within 24 hours of performing tests.
    - a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.
- B. Install sound-absorbing insulation strips according to acoustical roof deck manufacturer's written instructions.

3.3 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

SECTION 075323 -  
ETHYLENE-PROPYLENE-  
DIENE-MONOMER (EPDM)  
ROOFING

- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 INSTALLATION OF SUBSTRATE BOARD

- A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches in adjacent rows.
  - 1. At steel roof decks, install substrate board at right angle to flutes of deck.
    - a. Locate end joints over crests of steel roof deck.
  - 2. Tightly butt substrate boards together.
  - 3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  - 4. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29.
  - 5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.
  - 6. Loosely lay substrate board over roof deck.

3.5 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Decking:
  - 1. Mechanically fasten slip sheet to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to wood panel decks.
    - a. Fasten slip sheet according to requirements in SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
    - b. Fasten slip sheet to resist specified uplift pressure at corners, perimeter, and field of roof.
  - 2. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows end joints staggered not less than 12 inches in adjacent rows.
    - a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
    - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    - c. Make joints between adjacent insulation boards not more than 1/4 inch in width.

SECTION 075323 -  
ETHYLENE-PROPYLENE-  
DIENE-MONOMER (EPDM)  
ROOFING

- d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
    - 1) Trim insulation so that water flow is unrestricted.
  - e. Fill gaps exceeding 1/4 inch with insulation.
  - f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
  - g. Loosely lay base layer of insulation units over substrate.
  - h. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to wood panel decks.
    - 1) Fasten insulation according to requirements in SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
    - 2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
3. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
- a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
  - b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
  - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  - d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
  - e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
    - 1) Trim insulation so that water flow is unrestricted.
  - f. Fill gaps exceeding 1/4 inch with insulation.
  - g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
  - h. Loosely lay each layer of insulation units over substrate.
  - i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
    - 1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
    - 2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    - 3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

D. Installation Over Concrete Decks:

- 1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.
  - a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
  - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  - c. Make joints between adjacent insulation boards not more than 1/4 inch in width.

SECTION 075323 -  
ETHYLENE-PROPYLENE-  
DIENE-MONOMER (EPDM)  
ROOFING

- d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
    - 1) Trim insulation so that water flow is unrestricted.
  - e. Fill gaps exceeding 1/4 inch with insulation.
  - f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
  - g. Loosely lay base layer of insulation units over substrate.
  - h. Adhere base layer of insulation to concrete roof deck according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
    - 1) Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft., and allow primer to dry.
    - 2) Set insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
    - 3) Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    - 4) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
- a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
  - b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
  - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  - d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
  - e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
    - 1) Trim insulation so that water is unrestricted.
  - f. Fill gaps exceeding 1/4 inch with insulation.
  - g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
  - h. Loosely lay each layer of insulation units over substrate.
  - i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
    - 1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
    - 2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    - 3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

SECTION 075323 -  
ETHYLENE-PROPYLENE-  
DIENE-MONOMER (EPDM)  
ROOFING

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  2. At internal roof drains, conform to slope of drain sump.
    - a. Trim cover board so that water flow is unrestricted.
  3. Cut and fit cover board tight to nailers, projections, and penetrations.
  4. Loosely lay cover board over substrate.
  5. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
    - a. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
    - b. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    - c. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- B. Install slip sheet over cover board and immediately beneath roofing.

3.7 ADHERED ROOFING INSTALLATION

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll membrane roof membrane and allow to relax before installing.
- C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeters.
- G. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- H. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.
- I. Adhere protection sheet over roof membrane at locations indicated.

SECTION 075323 -  
ETHYLENE-PROPYLENE-  
DIENE-MONOMER (EPDM)  
ROOFING

3.8 INSTALLATION OF BASE FLASHING

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

3.9 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075323

SECTION 078413 -  
PENETRATION  
FIRESTOPPING

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetration firestopping systems for the following applications:
  - a. Penetrations in fire-resistance-rated walls.
  - b. Penetrations in horizontal assemblies.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

SECTION 078413 -  
PENETRATION  
FIRESTOPPING

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Approval according to FM Approval 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
    - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
      - 1) UL in its "Fire Resistance Directory."
      - 2) Intertek Group in its "Directory of Listed Building Products."
      - 3) FM Approval in its "Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M Fire Protection Products.
    - b. Hilti, Inc.
    - c. Specified Technologies, Inc.
    - d. Tremco, Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

SECTION 078413 -  
PENETRATION  
FIRESTOPPING

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
  2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
  3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
  1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- D. Install fill materials by proven techniques to produce the following results:
  1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
  2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

SECTION 078413 -  
PENETRATION  
FIRESTOPPING

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
  2. Contractor's name, address, and phone number.
  3. Designation of applicable testing and inspecting agency.
  4. Date of installation.
  5. Manufacturer's name.
  6. Installer's name.

3.3 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078413

SECTION 078443 - JOINT  
FIRESTOPPING

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

SECTION 078443 - JOINT  
FIRESTOPPING

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
  - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
    - 1) UL in its "Fire Resistance Directory."
    - 2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M Fire Protection Products.
    - b. Hilti, Inc.
    - c. Rockwool International.
    - d. Specified Technologies, Inc.
    - e. Thermafiber, Inc.; an Owens Corning company.
    - f. Tremco, Inc.
  2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Accessories: Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

SECTION 078443 - JOINT  
FIRESTOPPING

- B. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- C. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- D. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:
  - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
  - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
  - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078443

SECTION 079200 - JOINT  
SEALANTS

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Mildew-resistant joint sealants.
5. Latex joint sealants.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples: For each kind and color of joint sealant required.
- C. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
  2. Joint-sealant manufacturer and product name.
  3. Joint-sealant formulation.
  4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Preconstruction laboratory test reports.
- C. Preconstruction field-adhesion-test reports.
- D. Field-adhesion-test reports.
- E. Sample warranties.

SECTION 079200 - JOINT  
SEALANTS

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
  3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with masonry substrates.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1.7 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Adfast.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.

SECTION 079200 - JOINT  
SEALANTS

- c. May National Associates, Inc.; a subsidiary of Sika Corporation.
  - d. Pecora Corporation.
  - e. Sika Corporation; Joint Sealants.
  - f. The Dow Chemical Company.
- B. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. GE Construction Sealants; Momentive Performance Materials Inc.
    - b. Pecora Corporation.
    - c. Permthane®/Acryl-R®; ITW Polymers Sealants North America.
    - d. Polymeric Systems, Inc.
    - e. Sherwin-Williams Company (The).
    - f. The Dow Chemical Company.
- C. Silicone, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - b. Pecora Corporation.
    - c. Sika Corporation; Joint Sealants.
    - d. The Dow Chemical Company.

2.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Adfast.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.
    - c. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - d. Pecora Corporation.
    - e. Sika Corporation; Joint Sealants.
    - f. The Dow Chemical Company.
    - g. Tremco Incorporated.

SECTION 079200 - JOINT  
SEALANTS

2.4 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation.
    - b. Pecora Corporation.
    - c. Sherwin-Williams Company (The).
    - d. Sika Corporation; Joint Sealants.
    - e. Tremco Incorporated.
  
- B. Urethane, M, NS, 25, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 25, Use NT.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation.
    - b. Sherwin-Williams Company (The).
  
- C. Urethane, M, NS, 25, T, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 25, Uses T and NT.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation.
    - b. Bostik, Inc.
    - c. Pecora Corporation.
    - d. Sika Corporation; Joint Sealants.

2.5 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
  
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. GE Construction Sealants; Momentive Performance Materials Inc.
    - b. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - c. Pecora Corporation.
    - d. The Dow Chemical Company.
    - e. Tremco Incorporated.

SECTION 079200 - JOINT  
SEALANTS

- C. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Everkem Diversified Products, Inc.
    - b. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - c. Pecora Corporation.
    - d. Sherwin-Williams Company (The).
    - e. Tremco Incorporated.

2.6 JOINT-SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Adfast.
    - b. Alcot Plastics Ltd.
    - c. BASF Corporation.
    - d. Construction Foam Products; a division of Nomaco, Inc.

2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material 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.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove laitance and form-release agents from concrete.
  - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.

SECTION 079200 - JOINT  
SEALANTS

- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Install sealant backings of kind 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.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- 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 in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
  - 1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
    - b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
  - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other

SECTION 079200 - JOINT  
SEALANTS

requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.4 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Construction joints in cast-in-place concrete.
    - b. .
  - 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT .
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .
  
- B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Tile control and expansion joints.
    - b. Vertical joints on exposed surfaces of unit masonry walls .
    - c. .
    - d. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Urethane, S, NS, 25, NT .
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .
  
- C. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. .
    - c. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT .
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors .

END OF SECTION 079200

SECTION 079219 -  
ACOUSTICAL JOINT  
SEALANTS

SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical joint sealants.

1.2 ACTION SUBMITTALS

- A. Product Data: For each acoustical joint sealant.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.

2.2 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C 834.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. GE Construction Sealants; Momentive Performance Materials Inc.
    - b. Hilti, Inc.
    - c. Pecora Corporation.
    - d. Tremco Incorporated.
    - e. USG Corporation.
  - 2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors .
- B. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

SECTION 079219 -  
ACOUSTICAL JOINT  
SEALANTS

PART 3 - EXECUTION

3.1 PREPARATION

- A. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer.

3.2 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

- A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

END OF SECTION 079219

SECTION 081433 - STILE AND  
RAIL WOOD DOORS

SECTION 081433 - STILE AND RAIL WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior stile and rail wood doors.
2. Interior fire-rated stile and rail wood doors.
3. Factory .

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Details of construction and glazing.
2. Door frame construction.
3. Factory-machining criteria.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data, including those for stiles, rails, panels, and moldings (sticking); and other pertinent data, including the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimensions and location of hardware, lite locations, and glazing thickness.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Clearances and undercuts.
6. Requirements for veneer matching.
7. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: For factory-finished doors .

1.3 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.4 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program .

SECTION 081433 - STILE AND  
RAIL WOOD DOORS

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Wood Door Assemblies: Complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure according to UL 10C or NFPA 252.
  - 1. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
- B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.2 MATERIALS

- A. Use only materials that comply with referenced standards and other requirements specified.
  - 1. Assemble exterior doors, including components, with wet-use adhesives complying with ASTM D 5572 for finger joints and with ASTM D 5751 for joints other than finger joints.
  - 2. Assemble interior doors, including components, with either dry-use or wet-use adhesives complying with ASTM D 5572 for finger joints and with ASTM D 5751 for joints other than finger joints.
- B. Panel Products: Any of the following unless otherwise indicated:
  - 1. Particleboard: ANSI A208.1, Grade M-2.
  - 2. Medium-density fiberboard (MDF,) complying with ANSI A208.2, Grade 130.
  - 3. Hardboard complying with ANSI A135.4.
  - 4. Veneer-core plywood.

2.3 INTERIOR STILE AND RAIL WOOD DOORS

- A. Interior Stile and Rail Wood Doors: Interior stock doors complying with AWI, AWMAC, and WI's Architectural Woodwork Standards and with other requirements specified.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Assa Abloy, Maiman.
    - b. ETO Doors Corp.
    - c. Karona by JELD-WEN.
    - d. Masonite Architectural.
    - e. VT Industries Inc.

SECTION 081433 - STILE AND  
RAIL WOOD DOORS

- f. ProCore Jeld-Wen
- 2. Architectural Woodwork Standards Grade: Custom.
- 3. Panel Designs: Indicated on Drawings. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- 4. Finish: Opaque.
- 5. Wood Species and Cut for Transparent Finish: Species indicated on Drawings, plain sawed/sliced .
- 6. Door Construction for Opaque Finish:
  - a. Stile and Rail Construction: Clear softwood; may be edge glued for width and finger jointed.
  - b. Stile and Rail Construction: Veneered, structural composite lumber or veneered edge- and end-glued lumber.
  - c. Raised-Panel Construction: Clear softwood lumber; edge glued for width.
  - d. Raised-Panel Construction: Shaped, medium-density fiberboard.
  - e. Flat-Panel Construction: orMedium-density fiberboard.
- 7. Stile and Rail Widths: Manufacturer's standard, but not less than the following:
  - a. Stiles, Top and Intermediate Rails: 4-1/2 inches .
  - b. Bottom Rails: 9 inches .
- 8. Flat-Panel Thickness: 1/2 inch .
- 9. Molding Profile (Sticking): As selected by Architect from manufacturer's full range.
- 10. Mark, label, or otherwise identify stile and rail wood doors as complying with WDMA I.S. 6A and grade specified.

2.4 INTERIOR FIRE-RATED STILE AND RAIL WOOD DOORS

- A. Interior Fire-Rated Stile and Rail Wood Doors: Fire-rated (20-minute rating or 45-minute rating, see Door Schedule) doors complying with AWI, AWMAC, and WI's Architectural Woodwork Standards and with other requirements specified.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Assa Abloy, Maiman.
    - b. Eggers Industries.
    - c. Karona by JELD-WEN.
    - d. Masonite Architectural.
    - e. VT Industries Inc.
  - 2. Architectural Woodwork Standards Grade: Custom.
  - 3. Panel Designs: Indicated on Drawings. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
  - 4. Finish: Opaque.
  - 5. Wood Species and Cut for Transparent Finish: Species indicated on Drawings, plain sawed/sliced .
  - 6. Door Construction for Opaque Finish: 1-3/4-inch- thick stiles and rails and veneered flat panels not less than 5/8 inch thick .
    - a. Stile and Rail Construction: Veneered, structural composite lumber or veneered edge- and end-glued lumber.
    - b. Raised-Panel Construction: Shaped medium-density fiberboard (MDF.)

SECTION 081433 - STILE AND  
RAIL WOOD DOORS

- c. Flat-Panel Construction: Medium-density fiberboard (MDF).
  - d. Edge Construction for Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
  - e. Edge Construction for Fire-Rated Pairs of Doors: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
  - f. Edge Construction for Fire-Rated Pairs of Doors: Provide formed-steel edges and astragals with intumescent seals.
    - 1) Finish steel edges and astragals with baked enamel same color as doors.
    - 2) Finish steel edges and astragals to match door hardware (locksets or exit devices).
7. Stile and Rail Widths: As indicated on Drawings.
- a. Stiles, Top and Intermediate Rails: 5 inches .
  - b. Bottom Rails: 9 inches .
8. Molding Profile (Sticking): Manufacturer's standard or As selected by Architect from manufacturer's full range.
9. Mark, label, or otherwise identify stile and rail wood doors as complying with WDMA I.S. 6A and grade specified.
- B. Interior Fire-Rated Stile and Rail Wood Doors: Fire-rated (90-minute rating) doors complying with AWI, AWMAC, and WI's Architectural Woodwork Standards and with other requirements specified.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Assa Abloy, Maiman.
    - b. Eggers Industries.
    - c. Karona by JELD-WEN.
    - d. Masonite Architectural.
    - e. VT Industries Inc.
  - 2. Performance Grade: WDMA I.S. 6A Standard Duty .
  - 3. Architectural Woodwork Standards Grade: Custom.
  - 4. Panel Designs: Indicate on Drawings. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
  - 5. Finish: Opaque.
  - 6. Wood Species and Cut for Transparent Finish: Species indicated on Drawings, plain sawed/sliced .
  - 7. Interior Fire-Rated Door Construction: 1-3/4-inch- thick, edged and veneered mineral-core stiles and rails and 1-1/8-inch- thick, veneered mineral-core raised panels.
  - 8. Edge Construction for Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
    - a. At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
      - 1) Screw-Holding Capability: 550 lbf according to WDMA T.M. 10.

SECTION 081433 - STILE AND  
RAIL WOOD DOORS

9. Edge Construction for Fire-Rated Pairs of Doors: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
  - a. At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
    - 1) Screw-Holding Capability: 475 lbf according to WDMA T.M. 10.
10. Edge Construction for Fire-Rated Pairs of Doors: Provide formed-steel edges and astragals with intumescent seals.
  - a. At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
    - 1) Screw-Holding Capability: 475 lbf according to WDMA T.M. 10.
  - b. Finish steel edges and astragals with baked enamel same color as doors.
  - c. Finish steel edges and astragals to match door hardware (locksets or exit devices).
11. Stile and Rail Widths: Manufacturer's standard, but not less than the following:
  - a. Stiles, Top and Intermediate Rails: 4-1/2 inches .
  - b. Bottom Rails: 9 inches .
12. Molding Profile (Sticking): As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
  1. Install fire-rated doors according to NFPA 80.
  2. Install smoke- and draft-control doors according to NFPA 105.
- C. Job-Fitted Doors:
  1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
    - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
  2. Machine doors for hardware.
  3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
  4. Clearances:
    - a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
    - b. Provide 3/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
    - c. Where threshold is shown on Drawings or scheduled, provide 1/4 inch 3/8 inch from bottom of door to top of threshold unless otherwise indicated.
    - d. Comply with NFPA 80 for fire-rated doors.
  5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.

SECTION 081433 - STILE AND  
RAIL WOOD DOORS

6. Bevel fire-rated doors 1/8 inch in 2 inches on lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory- Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.2 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081433

SECTION 081613 –  
FIBERGLASS ENTRY DOOR

**PART 1    GENERAL**

**1.1    SECTION INCLUDES**

- A.    Fiberglass Entry Doors

**1.2    RELATED SECTIONS**

- A.    07 27 00 – Air Barriers: Water-resistant barrier
- B.    07 92 00 – Joint Sealants: Sealants and caulking
- C.    08 80 00 - Glazing
- D.    08 71 00 – Door Hardware
- E.    09 90 00 - Painting and Coating

SECTION 081613 –  
FIBERGLASS ENTRY DOOR

### 1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
1. ASTM E 90 – Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
  2. ASTM E 283 – Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Difference Across the Specimen.
  3. ASTM E 330 – Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
  4. ASTM E 331 – Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
  5. ASTM E 413 – Classification for Rating Sound Insulation (STC).
  6. ASTM E 547 – Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference.
  7. ASTM E 1300 – Standard Practice for Determining Load Resistance of Glass in Buildings.
  8. ASTM E 1332 – Standard Classification for Determination of Outdoor-Indoor Transmission Class.
  9. ASTM E 1886 – Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missiles and Exposed to Cyclic Pressure Differentials.
  10. ASTM E 1996 – Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
  11. ASTM E 2235 – Standard Test Method for Determination of Decay Rates for Use in Sound Insulation Test Methods.
- B. California Reference Standard Code:
1. CA SFM 12-7A-1 – Materials and Construction Methods for Exterior Wildfire Exposure.
- C. Canadian Standard:
1. CAN4-S104 – Standard Method for Fire Tests of Door Assemblies.
- D. Environmental Protection Agency and Department of Energy:
1. Energy Star Program Requirements Product Specification for Residential Windows, Doors, and Skylights.
- E. Code of Federal Regulations:
1. CFR 1201 Part 2 – Safety Standard for Architectural Glazing Materials.
- F. Florida High Velocity Hurricane Zone (HVHZ) Testing Application Standards:
1. TAS 201 – Impact Test Procedures.
  2. TAS 202 – Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components Using Uniform Static Air Pressure.
  3. TAS 203 – Criteria for Testing Products Subject to Cyclic Wind Pressure Loading.
- G. National Accreditation & Management Institute (NAMI)
- H. National Fenestration Rating Council
1. NFRC 100 – Procedure for Determining Fenestration Product U-Factors.

SECTION 081613 –  
FIBERGLASS ENTRY DOOR

2. NFRC 200 – Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance (VT) at Normal Incidence.
3. NFRC 400 – Procedure for Determining Fenestration Product Air Leakage.

I. National Fire Protection Association

1. NFPA 252 – Standard Methods of Fire Tests of Door Assemblies

J. Underwriters Laboratory

1. UL 10B – Standard for Fire Testing Door Assemblies.
2. UL 10C – Standard for Positive Pressure Fire Tests of Door Assemblies.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Doors shall have a structural design pressure rating .
- B. Doors capable of resisting impact from windborne debris, when tested in accordance with ASTM E1886 and ASTM E1996
- C. Door Unit Air Leakage, NFRC 400, 1.57 psf (25 mph): 0.50 cfm per square foot of frame or less.
- D. Door Unit Water Penetration: No water penetration through door unit when tested in accordance with ASTM E 331 or ASTM E 547 with water applied at rate of 5 gallons per hour per square foot at 0 psf.
- G. Doors shall have a minimum/maximum U-Value of 0.20 and a minimum/maximum SHGC of 0.10
- H. Doors shall qualify for Energy Star Rating.

#### 1.5 SUBMITTALS

- A. Refer to Division 01 33 00 Submittal Procedures [Insert division number and title].
- B. Product Data: Submit door manufacturer current product literature, including installation instructions.
- C. Shop Drawings: Submit manufacturer's shop drawings, indicating dimensions, construction, component connections, anchorage methods and locations, accessories, hardware locations, and installation details.
- D. Samples: Submit full-size or partial full-size verification sample of door illustrating glazing system, quality of construction, texture, and color of finish

SECTION 081613 –  
FIBERGLASS ENTRY DOOR

**1.6 QUALITY ASSURANCE**

- A. Mockup:
  - 1. Provide sample unit of representative product size and using manufacturer approved installation methods to determine acceptability of door installation methods. Comply with Division 01 43 39 Quality Assurance
  - 2. Approved mockup shall represent minimum quality required for the Work.
  - 3. Approved mockup shall [not] remain in place within the Work.
- C. Quality Assurance Submittals:
  - 1. Provide documentation for specified performance as required.
  - 2. Manufacturers' installation instructions.
- D. Manufacturer Qualifications: Manufacturer shall have successful experience in producing the type of product required for project applications equivalent to the requirements for this project.

**1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Refer to Division 01 60 00 Product Requirements.
- B. Delivery: Deliver materials to site undamaged with labels clearly identifying manufacturer, product name, and installation instructions
- C. Storage: Store materials in an upright position, off ground, under cover, and protected from weather, direct sunlight, and construction activities.
- D. Handling: protect materials and finish during handling and installation to prevent damage.

**1.8 WARRANTY**

- A. Refer to Division 01 78 36 Warranties
- B. Therma-Tru® standard limited warranty for fiberglass Therma-Tru® Door Product and genuine Therma-Tru® components, including rot-resistant frames, mullions, and brickmould sourced from Therma-Tru (excluding primed pine door frames and oak door

SECTION 081613 –  
FIBERGLASS ENTRY DOOR

frames, and non-rot resistant mullions and brickmould) used in commercial and multi-residential projects will be free from material and workmanship defects for a period of three years subject to certain limitations and restrictions. For complete details and current warranty information go to [www.thermatru.com](http://www.thermatru.com).

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURER**

- A. Basis of design:  
Therma-Tru Corp.  
1750 Indian Wood Circle  
Maumee, OH 43537  
(419) 891-7400  
(800) 843-7628  
[www.thermatru.com](http://www.thermatru.com)  
Contact:  
Rod Clark  
458-206-8532  
[rclark@thermatru.com](mailto:rclark@thermatru.com)
  
- B. Substitutions: ARE permitted
  
- B. Requests for substitutions will be considered in accordance with provisions of Division 01 60 00.

### **2.2 FIBERGLASS ENTRY DOORS**

- A. Fiberglass Entry Doors: All fiberglass doors manufactured by Therma-Tru®. Specification is for complete entry systems with components manufactured by Therma-Tru® and assembled by independent fabricators.
  - 1. Smooth-Star®
  - 2. Construction:
    - c. Smooth Star®  
1/16-inch minimum thickness, proprietary fiberglass-reinforced thermoset composite, surface lightly textured. Door edges are machinable kiln-dried pine, primed, lock edge reinforced with engineered lumber core, lockset area reinforced with solid blocking for hardware backup. Door bottom edge is moisture- and decay-resistant composite. Core is foamed-in-place polyurethane, density 1.9 pcf minimum.
  - 3. Door Style
    - c. See Drawings

SECTION 081613 –  
FIBERGLASS ENTRY DOOR

B. Frames: Provided and assembled by third party fabricators to exacting specifications from Therma-Tru to help maximize system performance. Therma-Tru® strongly recommends the use of rot-resistant frames, mullions, and brickmould sourced from Therma-Tru, however, the use of a non Therma-Tru® frame system (or a Therma-Tru Primed Pine Frame or Therma-Tru Oak Frame) will not automatically void the entire limited warranty. Refer to 1.8.B for clarification.

1. Jamb Width Standard 4 9/16”.
2. Rot Resistant – frames, mullions, and brickmould sourced through Therma-Tru.

C. Sills

1. Inswing: Composite Adjustable
2. Outswing: Aluminum with Thermal Break
3. Other: Public Access Sill
4. Finish: Mill

**2.3 HARDWARE**

SECTION 081613 –  
FIBERGLASS ENTRY DOOR

- A. Hinges: Steel, ball bearing, 4 x 4 x 0.098 inches finished to match hardware, plated screws to match
  - 1. Finish: [US4, Zinc dichromate] [US3, bright brass] [US5, antique brass] [US15, brushed nickel] [US17A, black nickel] [US15A, antique nickel] [US26, polished chrome] [US10B, oil rubbed bronze] [US32D stainless steel]
  
- B. Locking Hardware:
  - 1. Multi-point lock system includes stainless steel face plate.
  - 3. Finish: [US3, bright brass] [US5, antique brass] [US15, brushed nickel] [US17A, black nickel] [US15A, antique nickel] [US26, polished chrome] [US10B, oil rubbed bronze] [BY, white]

**2.4 GLAZING**

- 1. Therma-Tru factory glazed with double-pane construction.

**2.5 INSTALLATION ACCESSORIES**

- A. Sill pan
- B. Corner seal pad
- C. Rain deflector
- D. Rain Guard

**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Examine areas to receive doors. Notify Architect in writing any unacceptable conditions that would adversely affect installation or subsequent performance of the product. Do not proceed with installation until unsatisfactory conditions are corrected.

**3.2 INSTALLATION**

SECTION 081613 –  
FIBERGLASS ENTRY DOOR

- A. Install fiberglass doors in full compliance with Therma-Tru® written instructions and approved shop drawings.
- B. Maintain alignment and compatibility with adjacent work.

**3.3 FINISHING**

- A. Finish in compliance with Therma-Tru® written recommendations. Guidance for proper finishing is available at [www.thermatru.com](http://www.thermatru.com) – “Recommendations for Proper Finishing and Painting or Staining.”

**3.3 Protection**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products prior to Substantial Completion in accordance with Therma-Tru written recommendations. Guidance for proper finishing is available at [www.thermatru.com](http://www.thermatru.com) – “Recommendations for Proper Finishing and Painting or Staining.”

**END OF SECTION  
081613**

SECTION 085200 - WOOD  
WINDOWS

SECTION 085200 - WOOD WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes aluminum-clad wood windows.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace wood windows that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. Window: 10 years from date of Substantial Completion.
    - b. Glazing Units: 10 years from date of Substantial Completion.
    - c. Aluminum-Cladding Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

SECTION 085200 - WOOD  
WINDOWS

1. Window Certification: WDMA certified with label attached to each window.
  - B. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40 .
- 2.2 WOOD WINDOWS
- A. Aluminum-Clad Wood Windows:
    1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - a. Marvin Windows and Doors.
      - b. Pella Corporation.
      - c. Sierra Pacific Windows; Sierra Pacific Industries.
      - d. Kolbe Windows and Doors
  - B. Operating Types: As indicated on Drawings .
  - C. Frames and Sashes: Fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch deep by 2 inches wide; water-repellent preservative treated.
    1. Exterior Finish: Aluminum-clad wood.
      - a. Aluminum Finish: Manufacturer's standard baked-on enamel finish .
      - b. Exposed Unfinished Wood Surfaces: Pine .
      - c. Color: As selected by Architect from manufacturer's full range .
    2. Interior Finish: Unfinished .
      - a. Exposed Unfinished Wood Surfaces: Pine .
      - b. Color: As selected by Architect from manufacturer's full range .
  - D. Insulating-Glass Units: ASTM E 2190.
    1. Glass: ASTM C 1036, Type 1, Class 1, q3.
      - a. Tint: Clear .
      - b. Kind: Fully tempered where indicated on Drawings .
    2. Lites: Two .
    3. Filling: Fill space between glass lites with argon.
    4. Low-E Coating: Sputtered on third surface .
  - E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal .
  - F. Hardware, General: Provide manufacturer's standard corrosion-resistant hardware sized to accommodate sash weight and dimensions.
    1. Exposed Hardware Color and Finish: As indicated by manufacturer's designations .
  - G. Hung Window Hardware:

SECTION 085200 - WOOD  
WINDOWS

1. Counterbalancing Mechanism: AAMA 902.
  2. Locks and Latches: Operated from the inside only.
  3. Tilt Hardware: Releasing tilt latch allows sash to pivot about horizontal axis.
- H. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
- I. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.3 ACCESSORIES

2.4 INSECT SCREENS

- A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.
1. Type and Location: Full, outside for double-hung sashes.
- B. Aluminum Frames: Complying with SMA 1004 or SMA 1201.
1. Finish for Interior Screens: Baked-on organic coating in color selected by Architect from manufacturer's full range .
  2. Finish for Exterior Screens: Baked-on organic coating in color selected by Architect from manufacturer's full range .
- C. Glass-Fiber Mesh Fabric: 18-by-14 or 18-by-16 mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D 3656/D 3656M.
1. Mesh Color: Manufacturer's standard .

2.5 FABRICATION

- A. Fabricate wood windows in sizes indicated. Include a complete system for installing and anchoring windows.
- B. Glaze wood windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

SECTION 085200 - WOOD  
WINDOWS

- E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- D. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.
- E. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 085200

## SECTION 08 62 00 –UNIT SKYLIGHTS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Venting deck mount unit skylight with formed counter flashing for mounting on the roof deck, for low-slope and steep-slope roofing applications.

#### 1.2 REFERENCE STANDARDS

- A. General: Applicable edition of references cited in this Section is current edition published on date of issue of Project specifications, unless otherwise required by building code in force.
- B. American Architectural Manufacturers Association ([www.aama.net](http://www.aama.net)), Window & Door Manufacturers Association ([www.wdma.com](http://www.wdma.com)), Canadian Standards Association ([www.csagroup.org/us/en/services](http://www.csagroup.org/us/en/services))
  - 1. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/ Specification for Windows, Doors, and Skylights (NAFS)
  - 2. CSA A440S1-19 – Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440
  - 3. AAMA 2603 – Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum and Panels
- C. ASTM International: [www.astm.org](http://www.astm.org):
  - 1. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
  - 2. ASTM E 108 - Standard Test Methods for Fire Tests of Roof Coverings
  - 3. ASTM E 283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
  - 4. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
  - 5. ASTM E 408 - Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques
  - 6. ASTM E 1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
  - 7. ASTM E 1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes
- D. Code of Federal Regulations:
  - 1. 29 CFR 1910.29 (e) (1) - Occupational Safety and Health Standards for Fall Protection Systems and Falling Object Protection – Criteria and Practices.
- E. Illuminating Engineering Society of North America (IESNA): [www.ies.org](http://www.ies.org):
  - 1. IESNA – The Lighting Handbook.
- F. National Fenestration Rating Council: [www.nfrccommunity.org](http://www.nfrccommunity.org):

## SECTION 08 62 00 –UNIT SKYLIGHTS

1. NFRC 100 - Procedure for Determining Fenestration Product U-factors
2. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

### 1.3 COORDINATION

- A. Coordinate unit skylight interior termination locations with structural layout, ceiling grid layouts, and other ceiling-mounted items.

### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site prior to delivery of unit skylight and installation of roof deck.

### 1.5 ACTION SUBMITTALS

- A. Product Data: For unit skylights. Include standard construction details, product performance characteristics, and material descriptions, dimensions of individual components and profiles, and finishes.
  1. Include test reports of qualified independent testing agency or third party certificates verifying compliance with performance requirements.
- B. Shop Drawings: For unit skylight work. Include plans, elevations, sections, details, and connections to supporting structure and other adjoining work.

### 1.6 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

### 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data.

### 1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer listed in this Section with minimum 30 years' experience in the US manufacturing similar products in successful use on similar projects and able to provide unit skylights meeting requirements.
  1. Approval of Manufacturers and Comparable Products: Submit the following in accordance with project substitution requirements, within time allowed for substitution review:
    - a. Completed and signed Substitution Request form.
    - b. Product data, including photometric data and independent test data indicating compliance with requirements.
    - c. Sample product warranty.

## SECTION 08 62 00 –UNIT SKYLIGHTS

### 1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of unit skylights that fail in materials or workmanship under normal use within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Deterioration of metals, metal finishes, dome, and other materials beyond normal weathering.
    - b. Breakage of glazing.
  2. Warranty Period:
    - a. Unit Skylight and Flashing Product Warranty: 10 years from date of purchase.
    - b. Unit Skylight and Flashing Installation "No Leak" Warranty: 10 years from date of purchase.
    - c. Hail Breakage Warranty for Skylight Glass: 10 years from the date of purchase on all insulated glass units using laminated glass.
    - d. Insulating Glass Seal Failure Warranty: 20 years from date of purchase.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products of **VELUX America LLC.**, Greenwood, SC 29648; [www.VELUXusa.com](http://www.VELUXusa.com); (800) 878-3589, [specifications@veluxusa.com](mailto:specifications@veluxusa.com).
- B. Substitutions: As permitted under Instructions to Bidders and Section 012500 "Substitution Procedures".
- C. Source Limitations: Obtain unit skylights through single source from single manufacturer.

#### 2.2 Venting Deck Mounted Solar Unit Skylight (VSS) Skylights

- A. System Description: Venting deck mounted unit skylight consisting of the following main integrated components – an interior condensation drainage gasket, pre-finished white wooden frame [Special order stain grade wooden frame available on request], exterior maintenance-free [aluminum] [copper] cladding/counter flashing, ASA corner keys, and an insulating thermal pane glass unit with two seals, warm edge spacer system, three coats of LoE<sup>3</sup> silver to increase visible light transmittance while reducing solar heat, and a continuous deck seal mounting system with durable foam seal. VS/E/S skylights shall be suitable for installation on roof decks ranging from 14 degrees up to 85 degrees from horizontal.
1. Basis of Design: **VELUX America, LLC, Model VSS Venting Deck Mount Skylight.**
  - B. Maintenance free exterior cladding: [Roll formed 0.57 mm aluminum frame coverings with neutral gray Kynar<sup>®</sup> polyvinylidene fluoride resin finish,] [0.55 mm copper frame coverings,] production engineered, and fabricated to fit exterior exposed surfaces.
    1. Unit Sizes: as indicated on Drawings.

SECTION 08 62 00 –UNIT SKYLIGHTS

- C. Operator for Opening and Closing Skylight:
  - 1. Solar operator (VSS) powered by a solar charged battery operator. Battery pack is a 9 cell Panasonic NiMH 10.8V, 2100 mA. 60 Hz rating assembly that uses a robust chain driven system to open the skylight 11 inches. Skylight provided with integral photovoltaic cells and rain sensor. A 2.4 GHz radio frequency remote control pad is standard component with each VSS.
- D. Weather stripping: Factory applied neoprene and thermoplastic elastomeric weather stripping throughout entire frame, profiled to effect weather seal.
- E. Insulated Glass Unit: Factory assembled with low emissivity exterior pane and clear interior pane separated by a stainless steel spacer sealing the space between panes with 90% argon gas.
  - 1. Exterior Pane: 0.125 inch (3mm) thick tempered glass with Neat® exterior coating and interior surface coated with three layers of low emissivity silver (LoE<sup>3</sup>) coating LoE<sup>3</sup> 366.
  - 2. Interior Pane:
    - a. Snow Load: Laminated, Two clear 0.12 inch (3 mm) tempered panes with a 0.030 inch (0.76 mm) clear polyvinyl butyral interlayer sandwiched together.
- F. Structural Sealant: Factory applied Instant glaze sealant, clear color, bonding the glass pane to the aluminum frame and suitable for external exposure.
- G. Mounting System: Continuous corrosion resistant mounting system with a durable foam seal and rough opening alignment notches.

Specifier: VS/E/S skylight supplied 26 mounting fasteners.

- H. Mounting Fasteners: 10 gauge 1.25 inch (32 mm), ring shank nails provided with skylight. Ring shank nails are double hot dipped zinc coated. The field installed nails secure skylight to roof deck as indicated in manufacturer's installation instructions.

2.3 Flashings

Specifier: Type EDL step flashing designed for use with roofing material less than 0.5 inch (13 mm) thick (typically asphalt shingles, cedar shingles and slate) and for use on roof slopes 14 degrees or greater and not more than 85 degrees. Type EDW high profile flashing designed for use with high profiled roofing materials (clay tile, concrete tile and cedar shakes) not greater than 4.75 inches (120 mm) in height, and for use on roof slopes 14 to 85 degrees. EDL or EDW flashing is required with skylight in order for VELUX 10 year "No Leak" warranty to be valid.

- A. Step Flashing: Roll formed aluminum, neutral grey finish, factory engineered and fabricated seams, consisting of head flashing, sill flashing, step flashing pieces and adhesive underlayment suitable for use on roof pitches 14 to 85 degrees from horizontal.
  - 1. Basis of Design: **VELUX America, LLC, EDL Step Flashing.**
  - 2. Size: As required for skylight sizes indicated.
  - 3. Material:

## SECTION 08 62 00 –UNIT SKYLIGHTS

- a. Head flashing 23 gauge (0.57 mm) thick aluminum with polyester lacquer finish.
- b. Sill flashing 22 gauge (0.65 mm) thick aluminum with Kynar 500 finish.
- c. Step pieces 27 gauge (0.42 mm) thick aluminum with polyester lacquer finish.
- d. Adhesive underlayment: 9 inches (229 mm) wide x 21 feet (6.4 m) length x 0.03 inch (0.8 mm) thick, SBS modified bitumen with white polyethylene backing sheet.

### 2.4 ACCESSORIES

- A. Pleated Blinds:  
Solar powered, [room darkening double pleated] [light filtering single pleated] fabric with [white] [beige] [special] color as indicated on drawings. 24 volt dc blinds operated via 2.4 GHz radio frequency [basic wall mounted remote control provided with blind].
- B. VELUX Active:  
Indoor climate control and monitoring system for use with VELUX skylights and blinds.
- C. Power supplies and electric controls are available but sold separately.
  - a. KLI 310 Wall mounted keypad for use with VSS.

### 2.5 PERFORMANCE REQUIREMENTS

- A. The VSS deck mounted skylight is independently tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS-17) for compliance with International Building Code, International Energy Conservation Code and International Residential Code as follows:
  1. Water Test Pressure: No water penetration noted as measured in accordance with ASTM E 331 with a test pressure differential of 720 Pa (15.0 psf).
  2. Air Leakage Rate: Maximum of 0.05 CFM/ft<sup>2</sup> of total unit area, measured at a pressure of 75 Pa (1.57 psf) in accordance with ASTM E 283.
  3. Canadian Air Infiltration/Exfiltration Rating: A3. (0.3 L/s/m<sup>2</sup> maximum)
  4. Design Pressure (DP):
    - a. [[04 Standard Laminated Pane] [89 standard Laminated Pane with i89 Coating]: [S06 and S01 sizes design pressure = +300/-65 psf (+14.4/-3.11 kPa)] [and] [M08 and smaller sizes design pressure = +400/-105 psf (+19.2/-5.03 kPa)].]
    - b. [[06 Impact Pane: [S06 and S01 sizes design pressure = +200/-65 psf (+9.58/-3.11 kPa)] [and] [M08 and smaller sizes design pressure = +230/-65 psf (+11.0/-3.11 kPa)].]
    - c. [[10 Snow Load Pane: [S06 and S01 sizes design pressure = DP = +800/-80 psf (+38.3/-3.83 kPa)] [and] [M08 and smaller sizes design pressure = +1150/-150 psf (+55.1/-7.18 kPa)] [and] [C06 and smaller sizes design pressure = +1300/-150 psf (+62.2/-7.18 kPa)].]
- B. Daylighting: Provide daylighting photometric performance comparable to basis of design product at layout indicated, based upon daylighting profile of March 21, 9:00 am local time, at Project location by simulation in accordance with IESNA guidelines.
- C. [Windborne-Debris Resistance: Wind Zone 3 or Less: Provide unit skylights capable of resisting impact from windborne debris, based on the pass/fail criteria as determined from

## SECTION 08 62 00 –UNIT SKYLIGHTS

testing glazed representative of those specified, according to ASTM E 1886 and ASTM E 1996. Missile Level C, Wind Zone 3 requirements, and +50/-50 psf cycle pressure minimum.]

- D. Fire Ratings for Roof Assemblies with Fire Classifications: Unit skylight tested in accordance with ASTM E 108 and listed as passing Burning Brand test with target classification of Class B.
- E. Energy Performance ratings for any size venting deck mounted unit skylight with tempered exterior glass pane and interior pane as follows:
  - 1. Thermal Transmittance: NFRC 100 maximum U-factor:
    - a. 10 Snow Load Laminated: 0.42 Btu/hr\*ft<sup>2</sup>\*deg F (2.4 W/m<sup>2</sup>\*deg C).
  - 2. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum SHGC:
    - a. 10 Snow Load Laminated: 0.23
  - 3. Visible Transmittance (Vt): NFRC 200 maximum Vt:
    - a. 10 Snow Load Laminated: 0.52
- F. Fall Protection Standard Compliance: 29 CFR 1910.29: Testing for all laminated venting deck mount unit skylights.

### 2.6 MATERIALS

- A. Aluminum Sheet: Flat sheet complying with ASTM B 209/B 209M.
- B. Joint Sealants: As specified in Section 079200 "Joint Sealants."
- C. Mastic Sealants: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

### 2.7 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with unit skylight installation only after unsatisfactory conditions have been corrected.

## SECTION 08 62 00 –UNIT SKYLIGHTS

### 3.2 INSTALLATION

- A. Install unit skylights in accordance with manufacturer's written instructions and approved shop drawings. Coordinate installation of units with installation of substrates, air and vapor retarders, roof insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that finished installation is weather tight.
  - 1. Anchor unit skylights securely to supporting substrates.
  - 2. Install unit skylights on curbs specified in another section with tops of curbs parallel to finished roof slope.
- B. Where metal surfaces of unit skylights will contact incompatible metal or corrosive substrates, including preservative-treated wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation recommended in writing by unit skylight manufacturer.
- C. Additional testing and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

### 3.3 CLEANING AND PROTECTION

- A. Clean exposed unit skylight surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- B. Replace glazing that has been damaged during construction period.
- C. Protect unit skylight surfaces from contact with contaminating substances resulting from construction operations.

END OF SECTION

SECTION 087100 - DOOR  
HARDWARE

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:
  - a. Swinging doors.
  - b. Sliding doors.
2. Electrified door hardware.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For electrified door hardware.
  1. Include diagrams for power, signal, and control wiring.
  2. Include details of interface of electrified door hardware and building safety and security systems.
- C. Samples: For each exposed product in each finish specified.
- D. Door hardware schedule.
- E. Keying schedule.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

SECTION 087100 - DOOR  
HARDWARE

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
  - 1. Scheduling Responsibility: Preparation of door hardware and keying schedule.
  - 2. 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.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
- B. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design" ICC A117.1 HUD's "Fair Housing Accessibility Guidelines" .

2.2 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allegion plc.
    - b. Hager Companies.
    - c. McKinney Products Company; an ASSA ABLOY Group company.
    - d. Stanley Commercial Hardware; a division of Stanley Security Solutions.

SECTION 087100 - DOOR  
HARDWARE

2.3 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
  - 1. Bored Locks: Minimum 1/2-inch latchbolt throw.
  - 2. Deadbolts: Minimum 1-inch bolt throw.
- C. Lock Backset: 2-3/4 inches unless otherwise indicated.
- D. Lock Trim:
  - 1. Levers: Cast.
  - 2. Escutcheons (Roses): Cast.
  - 3. Dummy Trim: Match lever lock trim and escutcheons.
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
  - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
  - 3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
  - 4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.
- F. Bored Locks: BHMA A156.2; Grade 2; Series 4000.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allegion plc.
    - b. Hager Companies.
    - c. SARGENT Manufacturing Company; ASSA ABLOY.
    - d. Stanley Commercial Hardware; a division of Stanley Security Solutions.
    - e. Yale Security Inc; an ASSA ABLOY Group company.

2.4 ELECTRIC STRIKES

- A. Electric Strikes: BHMA A156.31; Grade 1 ; with faceplate to suit lock and frame.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
    - b. Allegion plc.
    - c. Hager Companies.
    - d. HES, Inc.; an ASSA ABLOY Group company.
    - e. Stanley Commercial Hardware; a division of Stanley Security Solutions.

SECTION 087100 - DOOR  
HARDWARE

2.5 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
    - b. Allegion plc.
    - c. Hager Companies.
    - d. SARGENT Manufacturing Company; ASSA ABLOY.
    - e. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.6 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allegion plc.
    - b. Hager Companies.
    - c. SARGENT Manufacturing Company; ASSA ABLOY.
    - d. Stanley Commercial Hardware; a division of Stanley Security Solutions.
    - e. Yale Security Inc; an ASSA ABLOY Group company.
- B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.
1. Core Type: Interchangeable .

2.7 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.
1. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
    - a. Provide three cylinder change keys and five each of master and grand master keys.
  2. Keyed Alike: Key all cylinders to same change key.
- B. Keys: Brass.
1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
    - a. Notation: "DO NOT DUPLICATE."

SECTION 087100 - DOOR  
HARDWARE

2.8 KEY CONTROL SYSTEM

- A. Key Control Cabinet: BHMA A156.28; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Key Boxes and Cabinets.
    - b. GE Security, Inc.
    - c. HPC, Inc.
    - d. Lund Equipment Co., Inc.
    - e. MMF Industries.
    - f. TelKee; Oasis International.
  2. Wall-Mounted Cabinet: Grade 1 cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.

2.9 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; aluminum unless otherwise indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allegion plc.
    - b. Burns Manufacturing Incorporated.
    - c. Don-Jo Mfg., Inc.
    - d. Hager Companies.
    - e. Rockwood Manufacturing Company; an ASSA ABLOY Group company.

2.10 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allegion plc.
    - b. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
    - c. Hager Companies.
    - d. SARGENT Manufacturing Company; ASSA ABLOY.
    - e. Stanley Commercial Hardware; a division of Stanley Security Solutions.
    - f. Yale Security Inc; an ASSA ABLOY Group company.

SECTION 087100 - DOOR  
HARDWARE

2.11 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Allegion plc.
  - b. Don-Jo Mfg., Inc.
  - c. Hager Companies.
  - d. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
  - e. Trimco.

2.12 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Allegion plc.
  - b. Hager Companies.
  - c. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
  - d. SARGENT Manufacturing Company; ASSA ABLOY.

2.13 SLIDING DOOR HARDWARE

A. Sliding Door Hardware: BHMA A156.14; consisting of complete sets including rails, hangers, supports, bumpers, floor guides, and accessories indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Hager Companies.
  - b. Johnson, L. E., Products, Inc.
  - c. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.14 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Allegion plc.
  - b. Baldwin Hardware Corporation.
  - c. Don-Jo Mfg., Inc.
  - d. Hager Companies.
  - e. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
  - f. Trimco.

SECTION 087100 - DOOR  
HARDWARE

2.15 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

PART 3 - EXECUTION

3.1 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. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. 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 of door height greater than 90 inches.
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
  - 1. Replace construction cores with permanent cores as indicated in keying schedule .
  - 2. Furnish permanent cores to Owner for installation.
- F. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- G. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, in equipment room. Verify location with Architect.
  - 1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
- H. 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 will impede traffic.
- I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

SECTION 087100 - DOOR  
HARDWARE

1. Do not notch perimeter gasketing to install other surface-applied hardware.
- J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.2 ADJUSTING

- A. 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.

END OF SECTION 087100

## SECTION 088300 - MIRRORS

### SECTION 088300 - MIRRORS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes the following types of silvered flat glass mirrors:

1. Annealed monolithic glass mirrors.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

##### 1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing.

##### 1.4 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
1. Warranty Period: Five years from date of .

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Binswanger Mirror; a division of Vitro America, Inc.
  2. Gardner Glass, Inc.
  3. Guardian Glass; SunGuard.
  4. National Glass Industries.

## SECTION 088300 - MIRRORS

### 2.2 SILVERED FLAT GLASS MIRRORS

- A. Mirrors, General: ASTM C 1503 ; manufactured using copper-free, low-lead mirror coating process.
- B. Annealed Monolithic Glass Mirrors: Mirror Select Glazing Quality, clear .
  - 1. Nominal Thickness: 1/4 Inch .
- C. Safety Glazing Products: For mirrors, provide products that comply with 16 CFR 1201, Category II.

### 2.3 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating approved by mirror manufacturer.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. C.R. Laurence Co., Inc.
    - b. Liquid Nails Adhesive.
    - c. Palmer Products Corporation.
    - d. Pecora Corporation.

### 2.4 MIRROR HARDWARE

- A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.
  - 1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.04 inch.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Andscot Company, Inc.
      - 2) C.R. Laurence Co., Inc.
      - 3) Stylmark, Inc.
  - 2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.04 inch.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Andscot Company, Inc.

## SECTION 088300 - MIRRORS

- 2) C.R. Laurence Co., Inc.
- 3) Stylmark, Inc.
3. Finish: Clear bright anodized.

### 2.5 FABRICATION

- A. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.
- B. Mirror Edge Treatment: Rounded polished . Seal edges of mirrors with edge sealer.
- C. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint, as recommended in writing by film-backing manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

### 3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

### 3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
- B. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
  1. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
- C. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

SECTION 088300 - MIRRORS

END OF SECTION 088300

SECTION 092900 - GYPSUM  
BOARD

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum wallboard.
2. Gypsum board, Type X.
3. Gypsum ceiling board.
4. Mold-resistant gypsum board.
5. Glass-mat, water-resistant backing board.
6. Cementitious backer units.
7. Interior trim.
8. Joint treatment materials.
9. Sound-attenuation blankets.
10. Acoustical sealant.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

SECTION 092900 - GYPSUM  
BOARD

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Gypsum.
  - b. CertainTeed Gypsum.
  - c. Georgia-Pacific Gypsum LLC.
  - d. National Gypsum Company.
  - e. USG Corporation.
2. Thickness: 5/8 inch.
3. Long Edges: Tapered .

B. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Gypsum.
  - b. CertainTeed Gypsum.
  - c. Georgia-Pacific Gypsum LLC.
  - d. National Gypsum Company.
  - e. USG Corporation.
2. Thickness: 5/8 inch.
3. Long Edges: Tapered .

C. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Gypsum.
  - b. CertainTeed Gypsum.
  - c. Georgia-Pacific Gypsum LLC.
  - d. National Gypsum Company.
  - e. USG Corporation.
2. Thickness: 5/8 inch.
3. Long Edges: Tapered.

D. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Gypsum.
  - b. CertainTeed Gypsum.
  - c. Georgia-Pacific Gypsum LLC.
  - d. National Gypsum Company.
  - e. USG Corporation.
2. Core: 5/8 inch , Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

SECTION 092900 - GYPSUM  
BOARD

2.4 SPECIALTY GYPSUM BOARD

2.5 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Georgia-Pacific Gypsum LLC.
    - c. National Gypsum Company.
    - d. USG Corporation.
  2. Core: 5/8 inch , Type X.
  3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- B. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. CertainTeed Corporation.
    - b. National Gypsum Company.
    - c. USG Corporation.
  2. Thickness: 5/8 inch .
  3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet .
  2. Shapes:
    - a. Cornerbead.
    - b. L-Bead: L-shaped; exposed long flange receives joint compound.
    - c. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    - d. Expansion (control) joint.

2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
1. Interior Gypsum Board: Paper.
  2. Tile Backing Panels: As recommended by panel manufacturer.

SECTION 092900 - GYPSUM  
BOARD

- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
  - 1. Prefilling: At open joints , rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
  - 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
  
- D. Joint Compound for Tile Backing Panels:
  - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
  - 2. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.8 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
  
- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
  - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
  - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
  
- C. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
  
- D. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION AND FINISHING OF PANELS

- A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
  
- B. Comply with ASTM C840.
  
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge

SECTION 092900 - GYPSUM  
BOARD

trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

- D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- E. Prefill open joints , rounded or beveled edges, and damaged surface areas.
- F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Panels that are substrate for tile .
  - 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated .
    - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- H. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.
- I. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.2 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 093013 - CERAMIC  
TILING

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ceramic mosaic tile.
2. Glazed wall tile.
3. Stone thresholds.
4. Tile backing panels.
5. Waterproof membrane for thinset applications.
6. Crack isolation membrane.
7. Metal edge strips.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples:

1. Each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide samples of each color blend.
2. Stone thresholds.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
3. Installer employs only Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers for Project.

SECTION 093013 - CERAMIC  
TILING

4. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of mud floors mud walls membranes shower receptors gauged porcelain tile/gauged porcelain tile panels and slabs and large format tile.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

- A. Ceramic Tile Type CT- See Drawings: Factory-mounted glazed ceramic mosaic tile.
  1. Composition: Porcelain .
  2. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
  3. Dynamic Coefficient of Friction: Not less than 0.42.
  4. Grout Color: See Finish Schedule on Drawings .
  5. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
    - a. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.
- B. Ceramic Tile Type CT- See Finish Schedule on Drawings: Glazed wall tile.
  1. Face Size Variation: Rectified.
  2. Grout Color: See Finish Schedule .
  3. Mounting: Factory, back mounted.
- C. Accessories: Provide vitreous china accessories of type and size indicated, suitable for installing by same method as used for adjoining wall tile.
  1. One soap holder with grab handle for each shower and tub indicated.
  2. Color and Finish: As selected by Architect from manufacturer's full range .

SECTION 093013 - CERAMIC  
TILING

2.3 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
  - 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.
- B. Marble Thresholds: ASTM C503/C503M, with a minimum abrasion resistance of 10 according to ASTM C1353 or ASTM C241/C241M and with honed finish.
  - 1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.4 TILE BACKING PANELS

- A. Fiber-Cement Backer Board: ASTM C1288.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. James Hardie Building Products, Inc.
  - 2. Thickness: 5/8 inch.

2.5 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Boiardi Products Corporation; a QEP company.
    - b. Bonsal American, an Oldcastle company.
    - c. Bostik, Inc.
    - d. C-Cure.
    - e. Custom Building Products.
    - f. H.B. Fuller Construction Products Inc. / TEC.
    - g. LATICRETE SUPERCAP, LLC.
    - h. MAPEI Corporation.
    - i. Southern Grouts & Mortars, Inc.

SECTION 093013 - CERAMIC  
TILING

2.6 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product , selected from the following, that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Boiardi Products Corporation; a QEP company.
    - b. Bonsal American, an Oldcastle company.
    - c. Bostik, Inc.
    - d. Custom Building Products.
    - e. H.B. Fuller Construction Products Inc. / TEC.
    - f. LATICRETE SUPERCAP, LLC.
    - g. MAPEI Corporation.

2.7 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
- B. Standard Dry-Set Mortar (Thinset): ANSI A118.1.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Bonsal American, an Oldcastle company.
    - b. Bostik, Inc.
    - c. C-Cure.
    - d. Custom Building Products.
    - e. H.B. Fuller Construction Products Inc. / TEC.
    - f. LATICRETE SUPERCAP, LLC.
    - g. MAPEI Corporation.
  - 2. For wall applications, provide nonsagging mortar.
- C. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Bonsal American, an Oldcastle company.
    - b. Bostik, Inc.
    - c. C-Cure.
    - d. Custom Building Products.
    - e. H.B. Fuller Construction Products Inc. / TEC.
    - f. LATICRETE SUPERCAP, LLC.
    - g. MAPEI Corporation.
  - 2. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
  - 3. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
  - 4. For wall applications, provide nonsagging mortar.

SECTION 093013 - CERAMIC  
TILING

2.8 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.
- B. Standard Cement Grout: ANSI A118.6.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Bonsal American, an Oldcastle company.
    - b. Bostik, Inc.
    - c. C-Cure.
    - d. Custom Building Products.
    - e. H.B. Fuller Construction Products Inc. / TEC.
    - f. LATICRETE SUPERCAP, LLC.
    - g. MAPEI Corporation.
- C. High-Performance Tile Grout: ANSI A118.7.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Bonsal American, an Oldcastle company.
    - b. Bostik, Inc.
    - c. C-Cure.
    - d. Custom Building Products.
    - e. H.B. Fuller Construction Products Inc. / TEC.
    - f. LATICRETE SUPERCAP, LLC.
    - g. MAPEI Corporation.
  - 2. Polymer Type: Dry, redispersible form, prepackaged with other dry ingredients.
  - 3. Polymer Type: Liquid-latex form for addition to prepackaged dry-grout mix.
- D. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

2.9 MISCELLANEOUS MATERIALS

- A. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; nickel silver exposed-edge material.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Blanke Corporation.
    - b. Ceramic Tool Company, Inc.
    - c. Schluter Systems L.P.
- B. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

SECTION 093013 - CERAMIC  
TILING

- a. Bonsal American, an Oldcastle company.
- b. Custom Building Products.
- c. Jamo Inc.
- d. Southern Grouts & Mortars, Inc.
- e. Summitville Tiles, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  2. Verify that concrete substrates for tile floors installed with adhesives bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

SECTION 093013 - CERAMIC  
TILING

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
  - a. Tile floors in wet areas.
  - b. Tile floors consisting of tiles 8 by 8 inches or larger.
  - c. Tile floors consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
  1. Ceramic Mosaic Tile: 1/16 inch .
  2. Glazed Wall Tile: 1/16 inch .
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
  1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
  1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in modified dry-set mortar (thinset).
  2. Do not extend cleavage membrane waterproof membrane or crack isolation membrane under thresholds set in standard dry-set modified dry-set or improved modified dry-set mortar. Fill joints between such thresholds and adjoining tile set on cleavage membrane waterproof membrane or crack isolation membrane with elastomeric sealant.
- K. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile where exposed edge of tile flooring meets carpet,

SECTION 093013 - CERAMIC  
TILING

wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

- L. Floor Sealer: Apply floor sealer to cementitious grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.
- M. Install tile backing panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.
- N. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- O. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

END OF SECTION 093013

## SECTION 09 60 00.1 – SOUND CONTROL UNDERLAYMENT

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Section 06 00 00 Wood, Plastics and Composites.
- B. Section 07 00 00 Thermal and Moisture Protection.
- C. Section 09 00 00 Finishes

#### 1.2 RELATED SECTIONS

- A. Section 06 10 00 – Rough Carpentry: Installation and requirements for wood substrates and structure.
- B. Section 09 64 00 – Wood Flooring
- C. Section 09 6519 – Resilient Tile Flooring
- D. Section 096813 – Tile Carpeting.

#### 1.3 REFERENCES

- A. APA The Engineered Wood Association (APA): APA AFG-01 – Specification for field gluing subfloors.
- B. American Society for Testing and Materials (ASTM):
  - 1. ASTM C 209 - Test Methods for Cellulosic Fiber Insulating Board.
  - 2. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - 3. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials.
  - 4. UL listed, File R16381.
  - 5. Forest Stewardship Certification (FSC): CoC Cert no. 5682.
  - 6. ICC-ES Report ESR-1374.

#### 1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- 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.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 10 years experience in producing sound-deadening boards.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging with labels intact until ready for installation.
- B. Inspect the materials upon delivery to assure that specified products have been received. Report damaged material immediately to the delivering carrier and note such damage on the carrier's freight bill of lading.
- C. Store materials in a dry place, indoors, on raised platform protected from weather damage.

## 1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Climatize panels to existing moisture conditions and for not less than 24 hours before installation. Comply with manufacturer's recommendations for acclimatization.

## **PART 2 PRODUCTS**

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Homasote Company; 932 Lower Ferry Road, West Trenton, NJ 08628. Tel: (800) 257-9491. Tel: (609) 883-3300. Fax: (609) 883-3497. Email: sales@homasote.com Website: www.homasote.com
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 25 00.
- C. Provide all acoustical wall panels from a single manufacturer.

### 2.2 MATERIALS

- A. 440 SoundBarrier: Class C fire-rated. Molded, recycled post-consumer paper, cellulose fiber structural panel. Physical properties as follows..
  - 1. Thickness: 1/2 inch (13 mm).
  - 2. Density: 26-28 pcf (416-448 kg/cu. m) tested in accordance with ASTM C 209.
  - 3. Tensile Strength: When tested in accordance with ASTM C 209:

- a. Parallel: 450-700 psi (3,100-4,830 kPa).
- b. Transverse: 750-1000 psi (5.1171-6.894 kPa).
- 4. Hardness (Janka Ball): 230 lbs (104 kg) tested in accordance with ASTM D 1037.
- 5. Water Absorption by Volume: When tested in accordance with ASTM C 209:
  - a. 2 hour immersion: 7 percent maximum.
- 6. Expansion: 50 to 90 percent relative humidity, 0.25 percent in accordance with ASTM C 209.
- 7. Thermal Resistance: When tested in accordance with ASTM C 209 per ASTM C 518:
  - a. R-value: 1.2 for 1/2 inch (13 mm) thick board.
  - b. K-value: .512 Btu-in/ (h ft<sup>2</sup> °F).
- 8. Noise reduction coefficient (NRC): 0.20
- 9. Flame Spread: 76 to 200 tested in accordance with ASTM E 84, Class III or C.

## 2.3 ACCESSORIES

- A. Adhesive: APA AFG-01 specification sub-floor adhesive.
- B. Floor Panel Fasteners:
  - 1. Nails, Wood Framing: annular thread type (ring shank) of length required to penetrate not less than 3/4 inch (19 mm) into subfloor.
  - 2. Screws: Coarse thread drywall type wood screw of length required to penetrate not less than 3/4 inch (19 mm) into sub-floor.
- C. Wall Panel Fasteners:
  - 1. Nails, Wood Framing: Length required penetrating wood framing 3/4 inch (19 mm) minimum.
  - 2. Screws:
    - a. General: 20 gauge or heavier, self-tapping drywall type steel screw.
    - b. Wood Framing: Coarse thread drywall type wood screw, length as required to penetrate framing 3/4 inch (19 mm) minimum.
    - c. Metal Framing: 22-25 gauge, drywall type steel screw.
- D. Drywall fastener for decoupled wall installation.
  - 1. #10 drywall screw or laminating screw.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates upon which work will be installed.

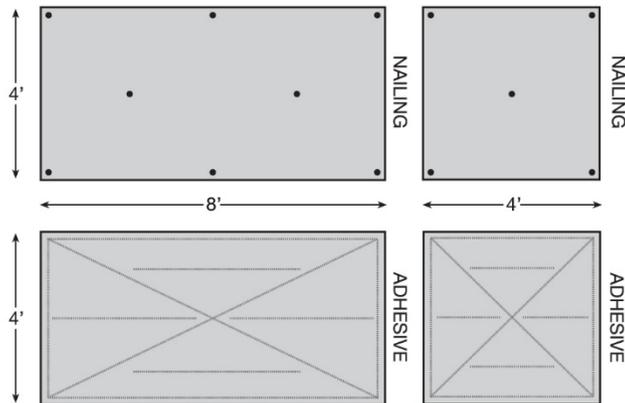
- B. Verify framing member spacing complies with manufacturer's requirements depending on substrates and installation methods.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Verify what environmental conditions are, and will continue to be maintained in accordance with manufacturer's recommendations.
- E. Starting work by installer is acceptance of substrate and environmental conditions.

### 3.2 PREPARATION

- A. Follow manufacturer's instructions by separating and allowing panels to be exposed to environmental temperature and humidity conditions for not less than 24 hours before start of installation.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install only clean dry panels. **Do not install wet panels.**
- C. Floor Panel Installation: Space panel joints 3/16 inch (5 mm) apart; 3/8 inch (10 mm) space at walls and partitions. Stagger joints.



- D. Wall Panel Installation: Space panel joints 1/8 inch (3 mm) apart; 1/4 inch (6 mm) space at floors, ceilings, and window and door frames. Install gypsum wallboard or other wall finish panels so that finish panel joints are staggered and do not coincide with sound barrier panel joints. Install in accordance with finish panel manufacturer's installation recommendations.

### 3.4 PROTECTION

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

### 3.5 CLEANING

- A. Comply with manufacturer's recommendations for repairing damaged panels.
- B. Replace panels that cannot be repaired.

**END OF SECTION – 09 60 00.1**

SECTION 096400 - WOOD  
FLOORING

SECTION 096400 - WOOD FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Factory-finished wood flooring.
  2. Sound control underlayment.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of floor assembly and accessory. Include plans, sections, and attachment details. Include expansion provisions and trim details.
- C. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hardwood Flooring: Comply with NWFA A500 for species, grade, and cut.
1. Certification: Provide flooring that carries NWFA grade stamp on each bundle or piece.
- B. Maple Flooring: Comply with applicable MFMA grading rules for species, grade, and cut.
1. Certification: Provide flooring that carries MFMA mark on each bundle or piece.
- C. Softwood Flooring: Comply with WCLIB No. 17 grading rules for species, grade, and cut.

2.2 FACTORY-FINISHED WOOD FLOORING

- A. Engineered-Wood Flooring: HPVA EF , meeting requirements for composite wood products.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Armstrong World Industries, Inc.
  2. Species: See Finish Schedule Sheets .
  3. Grade: Manufacturer's Standard .
  4. Thickness: 1/2 inch 3/8 inch .

SECTION 096400 - WOOD  
FLOORING

5. Construction: Three ply.
6. Face Width: See Finish Schedule Sheets .
7. Length: Manufacturer's standard.
8. Edge Style: Manufacturer's Standard .
9. Finish: UV urethane .
  - a. Color: As selected by Architect in manufacturer's full range .

2.3 SOUND CONTROL UNDERLAYMENT

- A. Sound Control Underlayment: Sound reducing underlayment consisting of impact-absorbing materials. Minimum Impact Insulation Class (IIC) of 50 when tested according to ASTM E492.
  1. Material: Manufacturer's Standard .
  2. Thickness: Manufacturer's Standard .

2.4 ACCESSORY MATERIALS

- A. Wood Underlayment: As specified in Section 096000 "Sound Control Underlayment"

PART 3 - EXECUTION

3.1 PREPARATION

- A. Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with flooring manufacturer's written installation instructions, but not less than applicable recommendations in NWFA's "Installation Guidelines."
- B. Wood Underlayment: Install according to requirements in Section 096000 "Sound Control Underlayment"
- C. Provide expansion space at walls and other obstructions and terminations of flooring of not less than 3/4 inch .
- D. Sound Control Underlayment: Install over vapor retarder according to manufacturer's written instructions.
- E. Solid-Wood Flooring: Blind nail or staple flooring to substrate.
  1. Plank Flooring: For flooring of face width more than 3 inches:
    - a. Hardwood: Install countersunk screws at each end of each piece in addition to blind nailing. Cover screw heads with wood plugs glued flush with flooring.

SECTION 096400 - WOOD  
FLOORING

- b. Softwood: Install no fewer than two countersunk nails at each end of each piece, spaced not more than 16 inches along length of each piece, in addition to blind nailing. Fill holes with matching wood filler.

F. Engineered-Wood Flooring: Install floating floor.

3.3 PROTECTION

A. Protect installed wood flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.

- 1. Do not move heavy and sharp objects directly over kraft-paper-covered wood flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096400

SECTION 096513 - RESILIENT  
BASE AND ACCESSORIES

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Thermoplastic-rubber base.
  2. Rubber stair accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC-RUBBER BASE (RB-1)

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Roppe Corporation, USA.
- B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).
1. Group: II (layered).
  2. Style and Location:
    - a. Style A, Straight: #00 Simplicity - PV4000 .
- C. Thickness: 0.25 inches .
- D. Height: 4 inches .
- E. Lengths: Coils in manufacturer's standard length .
- F. Outside Corners: Preformed .
- G. Inside Corners: Preformed .
- H. Colors: Match Architect's sample .

SECTION 096513 - RESILIENT  
BASE AND ACCESSORIES

2.2 RUBBER STAIR ACCESSORIES (RFT-1)

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Roppe Corporation, USA.
- C. Stair Treads: ASTM F 2169.
  - 1. Type: TS (rubber, vulcanized thermoset) .
  - 2. Class: 1 (smooth, flat) 2 (pattern; embossed, grooved, or ribbed).
  - 3. Group: 1 (embedded abrasive strips) 2 (with contrasting color for the visually impaired).
  - 4. Nosing Style: Square .
  - 5. Nosing Height: 1 9/16 inches .
  - 6. Thickness: 13/64 inches and tapered to back edge .
  - 7. Size: Lengths and depths to fit each stair tread in one piece .
  - 8. Integral Risers: Smooth, flat; in height that fully covers substrate.
- D. Separate Risers: Smooth, flat; in height that fully covers substrate; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
  - 1. Style: Manufacturer's Standard.
  - 2. Thickness: Manufacturer's standard .
- E. Landing Tile: Matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads .
- F. Locations: Provide rubber stair accessories in areas indicated .
- G. Colors and Patterns: Match Architect's sample .

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

SECTION 096513 - RESILIENT  
BASE AND ACCESSORIES

- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Form without producing discoloration (whitening) at bends.
  - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Miter or cope corners to minimize open joints.

3.3 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
  - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
  - 2. Tightly adhere to substrates throughout length of each piece.
  - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

SECTION 096513 - RESILIENT  
BASE AND ACCESSORIES

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.
  - 1. Apply one coat(s).
- C. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096813 - TILE  
CARPETING

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modular carpet tile.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

- C. Samples: For each exposed product and for each color and texture required.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

SECTION 096813 - TILE  
CARPETING

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.7 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE See Finish Schedule on Drawings

- A. Primary Backing/Backcoating: Manufacturer's standard composite materials .
- B. Size: See Basis of Design on Drawings Finish Schedule .
- C. Applied Treatments:
  - 1. Soil-Resistance Treatment: Manufacturer's standard treatment .
  - 2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:
    - a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
- D. Performance Characteristics:
  - 1. Appearance Retention Rating: Moderate traffic, 2.5 minimum according to ASTM D7330.
  - 2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
  - 3. Dry Breaking Strength: Not less than 100 lbf according to ASTM D2646.
  - 4. Tuft Bind: Not less than Manufacturer's Standard according to ASTM D1335.
  - 5. Delamination: Not less than 3.5 lbf/in. according to ASTM D3936.
  - 6. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
  - 7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
  - 8. Noise Reduction Coefficient (NRC): according to ASTM C423.
  - 9. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
  - 10. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) according to AATCC 16, Option E.
  - 11. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

SECTION 096813 - TILE  
CARPETING

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Wood Subfloors: Verify that underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

3.2 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive .
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.

SECTION 096813 - TILE  
CARPETING

- D. Maintain pile-direction patterns indicated on Drawings .
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.
- I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.
- J. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

## SECTION 099000 - PAINTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes surface preparation and field painting of the following:
  - 1. Exposed exterior items and surfaces.
  - 2. Exposed interior items and surfaces.
  - 3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.
  - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
  - 1. Prefinished items include the following factory-finished components:
    - a. Architectural woodwork and casework.
    - b. Finished mechanical and electrical equipment.
    - c. Light fixtures.
    - d. Distribution cabinets.
  - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
    - a. Foundation spaces.
    - b. Furred areas.
    - c. Ceiling plenums.
    - d. Pipe spaces.
  - 3. Finished metal surfaces include the following:
    - a. Anodized aluminum.
    - b. Stainless steel.
    - c. Chromium plate.
    - d. Copper.
    - e. Bronze and brass.
  - 4. Operating parts include moving parts of operating equipment and the following:
    - a. Valve and damper operators.
    - b. Linkages.

- c. Sensing devices.
  - d. Motor and fan shafts.
5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include the following:

- 1. Division 2 Section "Hot-Mix Asphalt Paving" for traffic-marking paint.
- 2. Division 8 Section "Steel Doors and Frames" for shop priming steel doors and frames.
- 3. Division 9 Section "Gypsum Board Assemblies" for surface preparation for gypsum board.
- 4. Division 9 Section "Intumescent Painting" for fire rated painting protection on structural steel

### 1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

- 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
- 2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
- 3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
- 4. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
- 5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

### 1.4 SUBMITTALS

A. Product Data: For each paint system specified. Include block fillers and primers.

- 1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
- 2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
- 3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
- 4. Tints/Colorants Shall Add No VOC

B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.

- 1. After color selection, the Architect will furnish color chips for surfaces to be coated.

C. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Coating Maintenance Manual: Upon conclusion of the project the Contractor or paint supplier/manufacturer shall furnish a coating maintenance manual, such as Sherwin Williams "Custodian Project Color and Product Information" report or equal. Manual shall include an Area

Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch up procedures, and color samples of each color and finish used.

#### 1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
  - 1. Product name or title of material.
  - 2. Product description (generic classification or binder type).
  - 3. Manufacturer's stock number and date of manufacture.
  - 4. Contents by volume, for pigment and vehicle constituents.
  - 5. Thinning instructions.
  - 6. Application instructions.
  - 7. Color name and number.
  - 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
  - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

#### 1.7 PROJECT CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F (10 and 32 deg C).
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 deg F (7.2 and 35 deg C).
- C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
  - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

#### 1.8 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials in unopened, factory-sealed containers for storage and identify with labels describing contents. Deliver extra materials to the Owner.
  - 1. Quantity: Furnish the Owner with an additional 5 percent, but not less than 1 gal. (3.785 L) or 1 case, as appropriate, of each material and color applied.

## **PART 2 - PRODUCTS**

### **2.1 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 the paint schedules.
- B. Manufacturers Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:
  - 1. Devoe & Reynolds Co. (Devoe).
  - 2. Fuller-O'Brien Paints (Fuller).
  - 3. Benjamin Moore & Co. (Moore).
  - 4. PPG Industries, Inc. (PPG).
  - 5. Pratt & Lambert, Inc. (P & L).
  - 6. Sherwin-Williams Co. (S-W).

### **2.2 PAINT MATERIALS, GENERAL**

- A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
  - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. Colors: Provide color selections made by the Architect.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.
  - 1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
  - 2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
  - 1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

## 3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
  - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
  - 1. Provide barrier coats over incompatible primers or remove and reprime.
  - 2. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. 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 of surface preparation.
    - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
    - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
    - c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
  - 3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
    - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
    - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.
    - c. When transparent finish is required, backprime with spar varnish.
    - d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on backside.
    - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
  - 4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
    - a. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 10.
    - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

- c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
  - 5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
  - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
  - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
  - 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

### 3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
  - 1. Paint colors, surface treatments, and finishes are indicated in the schedules.
  - 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
  - 3. Provide finish coats that are compatible with primers used.
  - 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
  - 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
  - 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
  - 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
  - 9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
  - 10. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
  - 1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
  - 2. Omit primer on metal surfaces that have been shop primed and touchup painted.
  - 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film

- thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
  2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
  3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:
1. Piping, pipe hangers, and supports.
  2. Heat exchangers.
  3. Tanks.
  4. Ductwork.
  5. Insulation.
  6. Motors and mechanical equipment.
  7. Accessory items.
- G. Electrical items to be painted include, but are not limited to, the following:
1. Conduit and fittings.
  2. Switchgear.
  3. Panelboards.
- H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- I. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Re-coat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
1. Provide satin finish for final coats.

### 3.4 FIELD QUALITY CONTROL

- A. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during the period when paint is being applied:
1. The Owner will engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.
  2. The testing agency will perform appropriate tests for the following characteristics as required by the Owner:
    - a. Quantitative material analysis.
    - b. Abrasion resistance.
    - c. Apparent reflectivity.
    - d. Flexibility.
    - e. Washability.
    - f. Absorption.
    - g. Accelerated weathering.
    - h. Dry opacity.
    - i. Accelerated yellowness.
    - j. Recoating.
    - k. Skinning.
    - l. Color retention.
    - m. Alkali and mildew resistance.
  3. The Owner may direct the Contractor to stop painting if test results show material being used does not comply with specified requirements. The Contractor shall remove noncomplying paint from the site, pay for testing, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected paint from previously painted surfaces if, on repainting with specified paint, the 2 coatings are incompatible.

### 3.5 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

### 3.6 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

### 3.7 EXTERIOR PAINT SCHEDULE

- A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
1. Low-Luster Acrylic Finish: 2 finish coats over a rust-inhibitive primer.

- a. Primer: Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils (0.033 mm).

- 1) S-W Pro Industrial Pro Cryl Primer B66 series
- 2) Devoe: 13101 Mirrolac Rust Penetrating Metal Primer.
- 3) Fuller: 621-04 Blox-Rust Alkyd Metal Primer.
- 5) Moore: IronClad Retardo Rust-Inhibitive Paint #163.
- 6) PPG: 6-208 Speedhide Interior/Exterior Rust Inhibitive Steel Primer, Red.
- 7) P & L: S/D 1009 Suprime "9" Interior/Exterior Alkyd Metal Primer.

- b. First and Second Coat: Low-sheen (eggshell or satin), exterior, acrylic-latex paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils (0.071 mm).

- 1) S-W Pro Industrial Acrylic B66-600
- 2) Devoe: 16XX Wonder-Shield Exterior Latex Satin House and Trim Paint.
- 3) Fuller: 261-XX Eggshell Sheen Latex House and Trim Paint.
- 5) Moore: MoorGard Latex House Paint #103.
- 6) PPG: 76 Line Sun-Proof Exterior House & Trim Acrylic Satin Latex.
- 7) P & L: Z/F 4200 Series Accolade Exterior Eggshell.

- B. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated (galvanized) metal surfaces:

1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a galvanized metal primer.

- a. Primer: Galvanized metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils (0.031 mm).

- 1) S-W Pro Industrial DTM Acrylic Primer/Finish B66W00011
- 2) Devoe: 8502/8520 Mirrolac-WB Interior/Exterior Waterborne Flat DTM Primer and Finish.
- 3) Fuller: 621-05 Blox-Rust Latex Metal Primer.
- 5) Moore: IronClad Galvanized Metal Latex Primer #155.
- 6) PPG: 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel.
- 7) P & L: Z/F 1003 Suprime "3" Interior/Exterior Latex Metal Primer.

- b. First and Second Coats: Semigloss, exterior, acrylic-latex enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils (0.066 mm).

- 1) S-W Pro Industrial DTM Acrylic Semi Gloss B66W01151
- 2) Devoe: 17XX Wonder-Shield Semi-Gloss Exterior Acrylic Latex House and Trim Paint.
- 3) Fuller: 664-XX Weather King II Semi-Gloss House & Trim Paint.
- 5) Moore: MoorGlo Latex House & Trim Paint #096.
- 6) PPG: 78 Line Sun-Proof Semi-Gloss Acrylic Latex House and Trim Paint.

7) P & L: Z/F 3100 Series Aqua Royal Latex House & Trim Finish.

C. Exterior Synthetic (Composite) Wood: Provide the following finishing systems over exterior wood surfaces:

1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over factory primer.

a. First and Second Coats: Semigloss, waterborne, exterior, acrylic enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.4 mils (0.061 mm).

- 1) Devoe: 17XX Wonder-Shield Semi-Gloss Exterior Acrylic Latex House and Trim Paint.
- 2) Fuller: 664-XX Weather King II Semi-Gloss House & Trim Paint.
- 3) Moore: MoorGlo Latex House & Trim Paint #096.
- 4) PPG: 78 Line Sun-Proof Semi-Gloss Acrylic Latex House and Trim Paint.
- 5) P & L: Z/F 3100 Series Aqua Royal Latex House & Trim Finish.
- 6) S-W: DTM Acrylic Coating Gloss (Waterborne) B66W100 Series.

### 3.8 INTERIOR PAINT SCHEDULE

A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:

1. Low-Luster, Acrylic-Enamel Finish: 2 finish coats over a primer.

a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils (0.031 mm).

- 1) S-W Multi Purpose Interior Exterior Primer/Sealer B51-450
- 2) Devoe: 50801 Wonder-Tones Interior Vinyl Latex Primer-Sealer.
- 3) Fuller: 220-20 Pro-Tech Interior Latex Wall Primer and Sealer.
- 5) Moore: Regal First Coat Interior Latex Primer & Underbody #216.
- 6) PPG: 17-10 Quick-Drying Interior Latex Primer-Sealer.
- 7) P & L: Z/F 1004 Suprime "4" Interior Latex Wall Primer.

b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils (0.071 mm).

- 1) S-W Super Paint Interior Latex Satin A87W01151
- 2) Devoe: 34XX Wonder-Tones Interior Latex Eggshell Enamel.
- 3) Fuller: 212-XX AA Enamel Acrylic Latex Eggshell Enamel.
- 5) Moore: Moore's Regal AquaVelvet #319.
- 6) PPG: 89 Line Manor Hall Eggshell Latex Wall and Trim Enamel.
- 7) P & L: Z/F 4000 Series Accolade Interior Velvet.

B. Stained Woodwork: Provide the following stained finishes over new, interior woodwork:

1. Alkyd-Based, Satin-Varnish Finish: 2 finish coats of an alkyd-based, clear-satin varnish over a sealer coat and an alkyd-based, interior wood stain. Wipe wood filler before applying stain.
  - a. Filler Coat: Paste-wood filler applied at spreading rate recommended by the manufacturer.
    - 1) Devoe: None required.
    - 2) Fuller: 680-00 Pen-Chrome Paste Wood Filler.
    - 3) Moore: Benwood Paste Wood Filler #238.
    - 4) PPG: None required.
    - 5) P & L: None required.
    - 6) S-W: Sher-Wood Fast-Dry Filler.
  - b. Stain Coat: Alkyd-based, interior wood stain applied at spreading rate recommended by the manufacturer.
    - 1) Devoe: 96XX WoodWorks Alkyd Interior Stain.
    - 2) Fuller: 640-XX Pen-Chrome Interior Oil Base Wood Stain.
    - 3) Moore: Benwood Penetrating Stain #234.
    - 4) PPG: 77-302 Rez Interior Semi-Transparent Stain.
    - 5) P & L: S-Series Tonetic Wood Stain.
    - 6) S-W: Oil Stain A-48 Series.
  - c. Sealer Coat: Clear sanding sealer applied at spreading rate recommended by the manufacturer.
    - 1) Devoe: 4900 WoodWorks Quick-Dry Clear Sealer.
    - 2) Fuller: None recommended.
    - 3) Moore: Moore's Interior Wood Finishes Quick-Dry Sanding Sealer #413.
    - 4) PPG: 77-30 Rez Interior Quick-Drying Sealer and Finish.
    - 5) P & L: H-40 Sanding Sealer.
    - 6) S-W: ProMar Varnish Sanding Sealer B26V3.
  - d. First and Second Finish Coats: Alkyd-based or polyurethane varnish, as recommended by the manufacturer, applied at spreading rate recommended by the manufacturer.
    - 1) Devoe: 4600 WoodWorks Alkyd Satin Varnish.
    - 2) Fuller: 653-01 EPA Compliant Clear Polyurethane Satin Finish.
    - 3) Moore: Benwood Satin Finish Varnish #404.
    - 4) PPG: 77-7 Rez Varnish, Interior Satin Oil Clear.
    - 5) P & L: H24 38 Clear Finish Gloss.
    - 6) S-W: Oil Base Varnish, Gloss A66V91.

C. Natural-Finish Woodwork: Provide the following natural finishes over new, interior woodwork:

1. Alkyd-Based, Satin-Varnish Finish: 2 finish coats of an alkyd-based, clear-satin varnish over a sanding sealer. Provide wood filler on open-grain wood before applying first varnish coat.
  - a. Filler Coat: Paste-wood filler applied at spreading rate recommended by the manufacturer.
    - 1) Devoe: None required.
    - 2) Fuller: 680-00 Pen-Chrome Paste Wood Filler.
    - 3) Moore: Benwood Paste Wood Filler #238.
    - 4) PPG: None required.
    - 5) P & L: None required.
    - 6) S-W: Sher-Wood Fast-Dry Filler.

- b. Sealer Coat: Clear sanding sealer applied at spreading rate recommended by the manufacturer.
- 1) Devoe: 4900 WoodWorks Quick-Dry Clear Sealer.
  - 2) Fuller: None recommended.
  - 3) Moore: Moore's Interior Wood Finishes Quick-Dry Sanding Sealer #413.
  - 4) PPG: 77-30 Rez Interior Quick-Drying Sealer and Finish.
  - 5) P & L: H-40 Sanding Sealer.
  - 6) S-W: ProMar Varnish Sanding Sealer B26V3.
- c. First and Second Finish Coats: Alkyd-based or polyurethane varnish, as recommended by the manufacturer, applied at spreading rate recommended by the manufacturer.
- 1) Devoe: 4600 WoodWorks Alkyd Satin Varnish.
  - 2) Fuller: 653-01 EPA Compliant Clear Polyurethane Satin Finish.
  - 3) Moore: Benwood Satin Finish Varnish #404.
  - 4) PPG: 77-7 Rez Varnish, Interior Satin Oil Clear.
  - 5) P & L: H24 38 Clear Finish Gloss.
  - 6) S-W: Oil Base Varnish, Gloss A66V91.

D. Ferrous Metal: Provide the following finish systems over ferrous metal:

1. Semigloss, Acrylic-Enamel Finish: One finish coat over an enamel undercoater and a primer.
  - a. Primer: Quick-drying, rust-inhibitive, alkyd-based or epoxy-metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils (0.038 mm).
    - 1) S-W Pro Industrial Pro Cryl Primer B66 series
    - 2) Devoe: 13101 Mirrolac Rust Penetrating Metal Primer.
    - 3) Fuller: 621-04 Blox-Rust Alkyd & Structural Metal Primer.
    - 5) Moore: IronClad Retardo Rust-Inhibitive Paint #163.
    - 6) PPG: 6-208 Speedhide Interior/Exterior Rust Inhibitive Steel Primer.
    - 7) P & L: S 4551 Tech-Gard High Performance Rust Inhibitor Primer.
  - b. Undercoat: Alkyd, interior enamel undercoat or semigloss, acrylic-latex, interior enamel, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils (0.033 mm).
    - 1) S-W Pro Industrial Acrylic Coating B66-600
    - 2) Devoe: 39XX Wonder-Tones Semi-Gloss Interior Latex Enamel.
    - 3) Fuller: 220-07 Interior Alkyd Enamel Undercoat.
    - 5) Moore: Moore's Alkyd Enamel Underbody #217.
    - 6) PPG: 6-6 Speedhide Interior Quick-Drying Enamel Undercoater.
    - 7) P & L: Z/F 4100 Series Accolade Interior Semi-Gloss.
  - c. Finish Coat: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils (0.033 mm).

- |    |         |  |
|----|---------|--|
| 1) | S-W     | Pro Industrial Acrylic Coating B66-600                                   |
| 2) | Devoe:  | 39XX Wonder-Tones Semi-Gloss Interior Latex Enamel.                      |
| 3) | Fuller: | 214-XX AA Enamel Interior Acrylic Latex Semi-Gloss Enamel.               |
| 5) | Moore:  | Moore's Regal AquaGlo Vinyl-Acrylic Latex Enamel #333.                   |
| 6) | PPG:    | 88-110 Satinhide Interior Enamel Wall & Trim Lo-Lustre Semi-Gloss Latex. |
| 7) | P & L:  | Z/F 4100 Series Accolade Interior Semi-Gloss.                            |

G. Woodwork and Hardboard: Provide the following paint finish systems over new, interior wood surfaces:

1. Low-Luster, Acrylic-Enamel Finish: 2 finish coats over a primer.

a. Primer: Alkyd- or acrylic-latex-based, interior wood primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.4 mils (0.036 mm).

- |    |         |   |
|----|---------|---|
| 1) | Devoe:  | 51701 Wonder-Prime All-Purpose Latex Primer Sealer & Vapor Barrier. |
| 2) | Fuller: | 220-07 Interior Alkyd Enamel Undercoat.                             |
| 3) | Moore:  | Moore's Alkyd Enamel Underbody #217.                                |
| 4) | PPG:    | 17-225 Quick-Drying Enamel Undercoater.                             |
| 5) | P & L:  | Z/F 1001 Suprime "1" 100 Percent Acrylic Multi-Purpose Primer.      |
| 7) | S-W     | Multi Purpose Interior Exterior Primer/Sealer B51-450               |

b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils (0.071 mm).

- |    |         |   |
|----|---------|---|
| 1) | S-W     | Super Paint Interior Latex Satin A87W01151        |
| 2) | Devoe:  | 34XX Wonder-Tones Interior Latex Eggshell Enamel. |
| 3) | Fuller: | 212-XX AA Enamel Acrylic Latex Eggshell Enamel.   |

- 5) Moore: Moore's Regal AquaVelvet #319.
- 6) PPG: 89 Line Manor Hall Interior Eggshell Latex Wall and Trim Enamel.
- 7) P & L: 4000 Series Accolade Interior Velvet.

**END OF SECTION 09 90 00**

SECTION 101423.16 - ROOM-  
IDENTIFICATION PANEL  
SIGNAGE

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes room-identification signs that are directly attached to the building.
- B. Related Requirements:
  - 1. Section 101416 "Plaques" for one-piece, solid metal signs, with or without frames, that are used for high-end room-identification.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification signs.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
  - 3. Show message list, typestyles, graphic elements , including raised characters and Braille, and layout for each sign at least half size .
- C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

SECTION 101423.16 - ROOM-  
IDENTIFICATION PANEL  
SIGNAGE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1 .

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign (Stairwells, Apartment Numbers, Mechanical Rooms): Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ASI Sign Systems, Inc.
    - b. Holland Engraving
    - c. Take Form
  2. Laminated-Sheet Sign: Acrylic face sheet with raised graphics laminated over subsurface graphics to acrylic backing sheet to produce composite sheet.
    - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign .
    - b. Surface-Applied Graphics: Applied vinyl film .
    - c. Color(s): As selected by Architect from manufacturer's full range .
  3. Sign-Panel Perimeter: Finish edges smooth.
    - a. Edge Condition : Square cut .
    - b. Corner Condition in Elevation: Square .
  4. Frame: Entire perimeter .
    - a. Material: Acrylic .
    - b. Profile: Square .
    - c. Corner Condition in Elevation: Square .
    - d. Finish and Color: As selected by Architect from manufacturer's full range .
  5. Mounting: Surface mounted to wall with two-face tape [**or**] .

2.3 SIGN MATERIALS

- A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

2.4 ACCESSORIES

- A. Adhesive: As recommended by sign manufacturer.

SECTION 101423.16 - ROOM-  
IDENTIFICATION PANEL  
SIGNAGE

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  - 1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
  - 2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  - 3. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
  - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Mounting Methods:
  - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
    - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
    - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
  - 2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
  - 3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive

SECTION 101423.16 - ROOM-  
IDENTIFICATION PANEL  
SIGNAGE

away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

4. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

END OF SECTION 101423.16

SECTION 102800 - TOILET,  
BATH, AND LAUNDRY  
ACCESSORIES

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Private-use bathroom accessories.
4. Underlavatory guards.
5. Custodial accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. 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.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Paper Towel (Roll) Dispenser See Toilet Accessory Legend on Drawings :

1. Mounting: Surface mounted.

- B. Automatic Paper Towel (Roll) Dispenser See Toilet Accessory Legend on Drawings :

1. Mounting: Surface mounted.

- C. Waste Receptacle :

SECTION 102800 - TOILET,  
BATH, AND LAUNDRY  
ACCESSORIES

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. American Specialties, Inc. (ASI).
  - c. Bobrick Washroom Equipment, Inc.
  - d. Bradley Corporation.
  - e. GAMCO Specialty Accessories; a division of Bobrick.
  - f. Tubular Specialties Manufacturing, Inc.
2. Mounting: Freestanding .
3. Minimum Capacity: .
4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin) .
5. Liner: Reusable vinyl liner .
6. Lockset: Tumbler type for waste receptacle.

D. Automatic Soap Dispenser :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Advanced Modern Technologies Corporation - AMTC.
  - b. AJW Architectural Products.
  - c. American Specialties, Inc. (ASI).
  - d. Bradley Corporation.
  - e. GAMCO Specialty Accessories; a division of Bobrick.
  - f. Sloan Valve Company.
2. Description: Automatic dispenser with infrared sensor to detect presence of hands; battery powered; designed for dispensing soap in liquid or lotion form.
3. Mounting: Surface mounted.
4. Capacity: .
5. Materials: .
6. Refill Indicator: LED indicator.
7. Low-Battery Indicator: LED indicator.

E. Grab Bar See Toilet Accessory Legend on Drawings :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. American Specialties, Inc.
  - c. Bobrick Washroom Equipment, Inc.
  - d. Bradley Corporation.
  - e. Tubular Specialties Manufacturing, Inc.
2. Mounting: Flanges with exposed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.
4. Outside Diameter: 1-1/2 inches.
5. Configuration and Length: As indicated on Drawings .

F. Sanitary-Napkin Disposal Unit See Toilet Accessory Legend on Drawings :

SECTION 102800 - TOILET,  
BATH, AND LAUNDRY  
ACCESSORIES

1. Mounting: Surface mounted.

G. Mirror Unit :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. American Specialties, Inc. (ASI).
  - c. Bobrick Washroom Equipment, Inc.
  - d. Bradley Corporation.
  - e. GAMCO Specialty Accessories; a division of Bobrick.
  - f. Tubular Specialties Manufacturing, Inc.
2. Frame: Stainless steel channel .
  - a. Corners: Welded and ground smooth.
3. Size: As indicated on Drawings .
4. Shelf:
  - a. Type: Exposed mounting.
  - b. Depth: 11 Inches .
5. Hangers: Manufacturer's standard rigid, tamper and theft resistant .

H. Hook See Toilet Accessory Legend on Drawings :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. American Specialties, Inc.
  - c. Bobrick Washroom Equipment, Inc.
  - d. Bradley Corporation.
  - e. Tubular Specialties Manufacturing, Inc.
2. Description: Double-prong unit .
3. Mounting: Exposed.
4. Material and Finish: Polished chrome-plated zinc alloy (zamac) .

2.3 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Robe Hook See Toilet Accessory Legend on Drawings :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. American Specialties, Inc.
  - c. Bobrick Washroom Equipment, Inc.
  - d. Bradley Corporation.
  - e. Seachrome Corporation.
  - f. Tubular Specialties Manufacturing, Inc.
2. Description: Double -prong unit.
3. Material and Finish: Polished chrome-plated zinc alloy (zamac) .

SECTION 102800 - TOILET,  
BATH, AND LAUNDRY  
ACCESSORIES

2.4 PRIVATE-USE BATHROOM ACCESSORIES

A. Private-Use Toilet Tissue Dispenser :

1. Products: Subject to compliance with requirements, provide the following:
  - a. ASI-American Specialties, Inc.
  - b. American Standard
  - c. Moen
2. Description: Double-roll dispenser with the following features:
  - a. Hood.
  - b. .
3. Mounting: Surface mounted.
4. Capacity: Designed for 4-1/2- or 5-inch- diameter tissue rolls.
5. Material and Finish: Solid brass, polished .

B. Private-Use Shower Curtain Rod :

1. Products: Subject to compliance with requirements, provide the following:
  - a. ASI-American Specialties, Inc.
2. Description: 1-inch- outside diameter, straight rod.
3. Configuration: As indicated on Drawings
4. Mounting Flanges: Designed for concealed fastening, in manufacturer's standard material and finish .
5. Rod Material and Finish: Solid brass, polished .
6. Features: Integral chrome-plated brass glide hooks.

C. Private-Use Robe Hook :

1. Products: Subject to compliance with requirements, provide the following:
  - a. ASI-American Specialties, Inc.
2. Description: Double -prong unit.
3. Material and Finish: Solid brass, polished .

D. Private-Use Towel Bar :

1. Products: Subject to compliance with requirements, provide the following:
  - a. ASI-American Specialties, Inc.
  - b. American Standard
  - c. Moen
2. Description: 3/4-inch- round tube with circular end brackets .
3. Mounting: Flanges with concealed fasteners.
4. Length: 24 inches .
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin) .

2.5 CUSTODIAL ACCESSORIES

A. Custodial Utility Shelf See Toilet Accessory Legend on Drawings :

SECTION 102800 - TOILET,  
BATH, AND LAUNDRY  
ACCESSORIES

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. American Specialties, Inc.
  - c. Bobrick Washroom Equipment, Inc.
  - d. Bradley Corporation.
  - e. Tubular Specialties Manufacturing, Inc.
2. Description: With exposed edges turned down not less than 1/2 inch and supported by two triangular brackets welded to shelf underside.
3. Size: 16 inches long by 6 inches deep .
4. Material and Finish: Not less than nominal 0.05-inch- thick stainless steel, ASTM A480/A480M No. 4 finish (satin).

B. Custodial Mop and Broom Holder See Toilet Accessory Legend on Drawings :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AJW Architectural Products.
  - b. American Specialties, Inc.
  - c. Bobrick Washroom Equipment, Inc.
  - d. Bradley Corporation.
  - e. Tubular Specialties Manufacturing, Inc.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf .
3. Length: 36 inches .
4. Hooks: Four .
5. Mop/Broom Holders: Three , spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
  - a. Shelf: Not less than nominal 0.05-inch- thick stainless steel.
  - b. Rod: Approximately 1/4-inch- diameter stainless steel.

## 2.6 FABRICATION

- A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of 4 keys to Owner's representative.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
  1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.

SECTION 102800 - TOILET,  
BATH, AND LAUNDRY  
ACCESSORIES

- C. Shower Seats: Install to comply with specified structural-performance requirements.

END OF SECTION 102800

SECTION 102819 - TUB AND  
SHOWER ENCLOSURES

SECTION 102819 - TUB AND SHOWER ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Semi-Frameless shower doors and enclosures.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For tub and shower doors and enclosures.
- C. Samples: For each type of exposed finish.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.4 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of tub and shower doors and enclosures that fail in materials or workmanship within specified warranty period, without monetary limitation.
  - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SEMI-FRAMELESS ENCLOSURES

- A. Glass panels with full perimeter frames of extruded aluminum with screw-fastened corners. Minimum 3/8-inch penetration of glass into frame. Framing members of thickness required to support imposed loads.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Alumax Bath Enclosures.
    - b. American Shower Door.
    - c. Artistcraft Shower Doors.
    - d. Basco, Inc.

SECTION 102819 - TUB AND  
SHOWER ENCLOSURES

- e. Cardinal Shower Enclosures; Hoskin & Muir, Inc.
- B. Frames, Hardware, and Trim: Manufacturer's standard units as indicated and as required for a complete installation.
  - 1. Materials: Aluminum; ASTM B221.
  - 2. Finish: Color anodic .
  - 3. Color: Manufacturers standard color options .
- C. Swinging Doors: Full-height piano hinge . Manufacturer's standard pulls and latch.
- D. Glazing: Safety glazing materials complying with 16 CFR 1201, Category II, with permanently etched identification acceptable to authorities having jurisdiction.
  - 1. Glass Nominal Thickness: 10 mm.
  - 2. Patterned Glass: ASTM C1048, Kind FT (fully tempered), Type II, Class 1 (clear), Form 3; Quality-Q6, Finish F1 (patterned, one side).
    - a. Pattern: Manufacturer's standard .
- E. Fasteners: Manufacturer's standard stainless steel or other noncorrosive fasteners.
- F. Sealant: Mildew-resistant, single-component, nonsag, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, for Use NT.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare and install per manufacturer's written instructions unless more stringent requirements are contained in GANA's "Glazing Manual."
- B. Clean substrates, removing projections, filling voids, and sealing joints.
- C. Set units level, plumb, and true to line, without warp or rack of frames and panels, and anchor securely in place.
- D. Fasten components securely in place, with provisions for thermal movement. Install with concealed fasteners unless otherwise indicated.
- E. Install components to drain and return water to tub or shower.
- F. Install doors to produce smooth operation and tight fit at contact points.
- G. Repair, refinish, or replace components damaged during installation.

3.2 ADJUSTING AND CLEANING

- A. Adjust operating parts and hardware for smooth, quiet operation and watertight closure. Lubricate hardware and moving parts.

SECTION 102819 - TUB AND  
SHOWER ENCLOSURES

- B. Remove nonpermanent labels, and clean surfaces immediately after installation.

END OF SECTION 102819

SECTION 104413 - FIRE  
PROTECTION CABINETS

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for portable fire extinguishers.

1.2 PREINSTALLATION CONFERENCE

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For fire-protection cabinets.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.

SECTION 104413 - FIRE  
PROTECTION CABINETS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Babcock-Davis.
  - b. Fire-End & Croker Corporation.
  - c. Guardian Fire Equipment, Inc.
  - d. JL Industries, Inc.; a division of the Activar Construction Products Group.
  - e. Larsens Manufacturing Company.
  - f. Nystrom.
  - g. Potter Roemer LLC; a Division of Morris Group International.
  
- B. Cabinet Construction: One-hour fire rated .
  1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- thick cold-rolled steel sheet lined with minimum 5/8-inch- thick fire-barrier material. Provide factory-drilled mounting holes.
  
- C. Cabinet Material: Aluminum sheet .
  
- D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
  1. Rolled-Edge Trim: 2-1/2-inch backbend depth.
  
- E. Cabinet Trim Material: Aluminum sheet .
  
- F. Door Material: Aluminum sheet .
  
- G. Door Style: Fully glazed panel with frame .
  
- H. Door Glazing: Tempered break glass .
  1. Acrylic Sheet Color: Clear transparent acrylic sheet.
  
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
  
- J. Accessories:
  1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
  
- K. Materials:
  1. Aluminum: ASTM B221 for extruded shapes and aluminum sheet, with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet.
    - a. Finish: Baked enamel or powder coat.
    - b. Color: As selected by Architect from full range of industry colors and color densities .
  2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, .

SECTION 104413 - FIRE  
PROTECTION CABINETS

3. Tempered Break Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.
4. Transparent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), 1.5 mm thick, with Finish 1 (smooth or polished) .

2.3 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare recesses for and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.
- B. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Identification: Apply decals at locations indicated.
- E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 104413

SECTION 104416 - FIRE  
EXTINGUISHERS

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Amerex Corporation.
    - b. Babcock-Davis.
    - c. Guardian Fire Equipment, Inc.

SECTION 104416 - FIRE  
EXTINGUISHERS

- d. JL Industries, Inc.; a division of the Activar Construction Products Group.
  - e. Kidde Residential and Commercial Division.
  - f. Larsens Manufacturing Company.
2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B , and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Regular Dry-Chemical Type : UL-rated nominal capacity, with sodium bicarbonate-based dry chemical in manufacturer's standard enameled container.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION 104416

SECTION 111200 - PARKING  
CONTROL EQUIPMENT

SECTION 111200 - PARKING CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Automatic barrier gates.
2. Vehicle detectors.

1.2 PREINSTALLATION MEETINGS

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For parking control equipment.

1. Include plans, elevations, sections and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 AUTOMATIC BARRIER GATES

- A. General: Provide parking control device consisting of operator and controller housed in a weathertight, tamper-resistant cabinet enclosure with gate arm. Device shall be activated by a

SECTION 111200 - PARKING  
CONTROL EQUIPMENT

signal from access or revenue control device. Fabricate unit with gate-arm height in down position of not more than 35 inches above pavement.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Amano Cincinnati, Inc.
    - b. ASPS Access Security & Parking Systems Inc.
    - c. Automatic Systems.
    - d. CAME Americas Automation LLC.
    - e. Canadian Parking Equipment Ltd./American Parking Equipment Inc.
    - f. Delta Scientific Corporation.
    - g. DoorKing, Inc.
    - h. Engineered Parking Systems, Inc.
    - i. Falcon Eye Global Security, LLC.
    - j. Magnetic Automation Corporation.
    - k. Parking Systems, Inc.
  2. Standards: Barrier gate operators that are listed and labeled according to UL 325 by a qualified testing agency.
- B. Controller: Factory-sealed, solid-state, plug-in type, with galvanized-steel box for wiring connections. Communicating type.
1. Communicating Type:
    - a. Real-time communication of lane counts, status messages, and execute commands.
    - b. Monitor illegal entries and exits, tailgates, tickets, monthlies, and backouts.
    - c. Status messages for gate up too long, backouts, ticket in chute, and gate-arm rebound.
    - d. Communication commands for resetting loops, turning "Full" signs on/off, raising and lowering gate arm, and disabling .
  2. Physical Characteristics:
    - a. On-off power supply switch.
    - b. Automatic-manual switch.
    - c. Differential counter.
    - d. Communication port.
    - e. Internal resettable counters.
    - f. Thermal-overload protection with manual reset.
    - g. Plug-in connectors for two vehicle loop detectors.
    - h. Thermostatically controlled heater with on/off/auto switch.
    - i. Thermostatically controlled fan with on/off/auto switch.
    - j. Switch to test motor and limit switches.
    - k. Emergency manual disconnect.
    - l. Battery backup.
    - m. Single , 115-V ac grounded power receptacle.
  3. Operational Characteristics:
    - a. Able to store successive inputs and sequentially processing each one.
    - b. Automatic instant-reversing obstacle detector mechanism that stops downward motion of gate arm if arm contacts or nears an object and that immediately returns arm to upward position. Include a zero- to 60-second, variable-time reset device.
    - c. Directional arming logic.
    - d. Broken gate-arm monitoring.
    - e. Programmable automatic timer.

SECTION 111200 - PARKING  
CONTROL EQUIPMENT

- f. Diagnostic mode for on-site testing , with LEDs for inputs and outputs.
  - g. Automatic and continuous testing of inputs and outputs.
  - h. Reversible arm capability for right- or left-handed operation.
- C. Cabinets: Fabricated from sheet metal with seams welded and ground smooth; approximately 15 inches square by 40 inches tall. Provide single, gasketed access door for each cabinet with flush-mounted locks. Furnish two keys for each lock , all locks keyed alike. Fabricate cabinet with internal reinforcing and four mounting holes accessible only from inside cabinet.
- 1. Aluminum Sheet: Not less than 0.125-inch- thick, aluminum sheet.
    - a. Finish cabinet, interior and exterior, with manufacturer's standard white baked-enamel or powder-coat finish.
- D. Straight Gate Arm: Aluminum.
- 1. Traffic-Side Face: Reflective painted finish and red diagonal stripes .
  - 2. Length: As indicated on Drawings .
  - 3. Mounting Flange: Provide with breakaway feature to ensure a clean break if arm is struck by vehicle.
- E. Operator: UL labeled and listed, Class II . 1/2 hp; -V, 60-Hz, single-phase, instant-reversing, continuous-duty motor for operating gate arm. Transmit power to gate-arm drive shaft through the speed reducer to harmonic-acting crank and connecting rod. Fabricate crank, rod, and drive shaft of galvanized solid bar steel. Provide an operable cam for adjusting arm travel.
- 1. Opening Time: Three seconds.
  - 2. Inherently adjustable, torque limiting clutch for safety.
- F. Characteristics:
- 1. Additional obstruction detector; noncontact infrared photoelectric radio-frequency barrier.
  - 2. Gate-arm warning safety signs on both sides of unit to limit traffic to vehicular traffic.
- 2.2 VEHICLE DETECTORS
- A. General: Provide detection devices that sense presence or transit of vehicles and emit signals activating gate-arm operators.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Amano Cincinnati, Inc.
    - b. ASPS Access Security & Parking Systems Inc.
    - c. Delta Scientific Corporation.
    - d. Engineered Parking Systems, Inc.
    - e. Magnetic Automation Corporation.
    - f. Parking Systems, Inc.
- B. Vehicle Loop Detector System: Self-tuning electronic presence detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light.

SECTION 111200 - PARKING  
CONTROL EQUIPMENT

Include automatic closing timer with adjustable time delay before closing , timer cut-off switch, designed to hold gate arm open until traffic clears. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement at location indicated on Drawings, as recommended in writing by detection system manufacturer for pave-over installation.

1. Field-Assembled Loop: Wire, in size indicated for field assembly.
  2. Operation:
    - a. Recognize vehicles within 6 inches of each other on standard-sized loop.
    - b. Recognize vehicle direction by detecting vehicle moving from one loop to another.
    - c. Generate reverse count if vehicle backs up after generating directional count in forward direction.
    - d. Continuous diagnostic monitoring and memory for intermittently operating and failed loops.
    - e. Crosstalk test between adjacent loops.
- C. Active Infrared Vehicle Detector: Emitter/receiver-type presence detector with adjustable detection zone pattern and sensitivity, designed to detect the presence or transit of vehicle in gate-arm pathway by interrupting infrared beam in zone pattern and to emit signal activating gate-arm operator. Include automatic closing timer with adjustable time delay before closing , timer cut-off switch, and vehicle presence detector designed to hold gate arm open until traffic clears.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install parking control equipment as required for complete and integrated installation.
  1. Rough-in electrical connections.

3.2 INSTALLATION OF AUTOMATIC BARRIER GATES

- A. Anchor cabinets to concrete bases with anchor bolts or expansion anchors, and mount barrier gate arms.
  1. Install barrier gates according to UL 325.

3.3 INSTALLATION OF VEHICLE DETECTORS

- A. Bury and seal wire loop at locations indicated on Drawings according to manufacturer's written instructions. Connect to parking control equipment operated by detector.

SECTION 111200 - PARKING  
CONTROL EQUIPMENT

3.4 INSTALLATION OF ELECTRICAL

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain parking control equipment.

END OF SECTION 111200

SECTION 123530 -  
RESIDENTIAL CASEWORK

SECTION 123530 - RESIDENTIAL CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes kitchen and vanity cabinets.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For residential casework. Include plans, elevations, details, and attachments to other work.
- C. Samples: For casework and hardware finishes.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For casework.

PART 2 - PRODUCTS

2.1 CABINETS

- A. Quality Standard: Provide cabinets that comply with KCMA A161.1.
  - 1. KCMA Certification: Provide cabinets with KCMA's "Certified Cabinet" seal affixed in a semiexposed location of each unit and showing compliance with KCMA A161.1.
- B. Door and Drawer Face Style: Flush overlay .
  - 1. Door and Drawer Fronts: Solid-wood stiles and rails, 3/4 inch thick, with 1/4-inch- thick, veneer-faced plywood center panels.
- C. Cabinet Style: Face frame .
  - 1. Face Frames: 3/4-by-1-5/8-inch solid wood with glued mortise and tenon or doveled joints.
- D. Exposed Cabinet End Finish: Thermoformed-vinyl-faced panels.

SECTION 123530 -  
RESIDENTIAL CASEWORK

2.2 CABINET MATERIALS

- A. Particleboard: ANSI A208.1, Grade M-2.
- B. Exposed Materials:
  - 1. Exposed Wood Species: Maple .
    - a. Select materials for compatible color and grain. Do not use two adjacent exposed surfaces that are noticeably dissimilar in color, grain, figure, or natural character markings.
    - b. Painting and Finish: As selected by Architect from manufacturer's full range.
- C. Semiexposed Materials: Unless otherwise indicated, provide the following:
  - 1. Vinyl-Faced Particleboard: MDF with embossed, wood-grain-patterned vinyl film adhesively bonded to particleboard.
    - a. Provide vinyl film on both sides of shelves, dividers, drawer bodies, and other components with two semiexposed surfaces and on semiexposed edges.
    - b. Colors, Textures, and Patterns: As selected by Architect from cabinet manufacturer's full range .
- D. Concealed Materials: Solid wood or plywood, of any hardwood or softwood species, with no defects affecting strength or utility; particleboard; MDF; or hardboard.

2.3 CABINET HARDWARE

- A. General: Manufacturer's standard units complying with BHMA A156.9, of type, size, style, material, and finish as selected by Architect from manufacturer's full range .
- B. Pulls: Back-mounted decorative pulls .
  - 1. Kitchens: See Interior Finish Schedule General Notes on Drawings
- C. Hinges: Concealed butt hingesSelf and Soft Closing, Adjustable. .
- D. Drawer Guides: Metal Ball Bearing undermount, full extension soft and self closing guides ; and complying with BHMA A156.9.
- E. Door and Drawer Bumpers: Self-adhering, clear silicone rubber.
  - 1. Doors: Provide one bumper at top and bottom of closing edge of each swinging door.
  - 2. Drawers: Provide one bumper on back side of drawer front at each corner.

SECTION 123530 -  
RESIDENTIAL CASEWORK

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install casework with no variations in adjoining surfaces; use concealed shims. Where casework abuts other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match casework.
- B. Install casework without distortion so doors and drawers fit the openings, are aligned, and are uniformly spaced. Complete installation of hardware and accessories as indicated.
- C. Install casework level and plumb to a tolerance of 1/8 inch in 8 feet.
- D. Fasten casework to adjacent units and to backing.
  - 1. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c.
    - a. Fasteners: No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips .
- E. Adjust hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.
- F. Clean casework on exposed and semiexposed surfaces. Touch up as required to restore damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION 123530

SECTION 123661.19 -  
QUARTZ AGGLOMERATE  
COUNTERTOPS

SECTION 123661.19 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops.
2. Quartz agglomerate backsplashes.

1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

- A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cambria.
    - b. Cosentino USA.
    - c. E. I. du Pont de Nemours and Company.
    - d. LG Chemical, Ltd.
    - e. Samsung Chemical USA, Inc.
    - f. Technistone USA, Inc.
    - g. Wilsonart LLC.
  2. Colors and Patterns: See Finish Schedule for Basis of Design .

2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."
  1. Grade: Economy.

SECTION 123661.19 -  
QUARTZ AGGLOMERATE  
COUNTERTOPS

- B. Configuration:
  - 1. Front: Straight, slightly eased at top .
  - 2. Backsplash: Straight, slightly eased at corner .
  - 3. End Splash: Matching backsplash .
- C. Countertops: 1/2-inch- thick, quartz agglomerate with front edge built up with same material.
- D. Backsplashes: 1/2-inch- thick, quartz agglomerate.
- E. Joints: Fabricate countertops in sections for joining in field , with joints at locations indicated.
- F. Cutouts and Holes:
  - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by quartz agglomerate manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions.
- B. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
- C. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.
- D. Install aprons to backing and countertops with adhesive.
- E. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- F. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.19

SECTION 21 13 13 –  
WET PIPE SPRINKLER SYSTEMS

SECTION 21 13 13 - WET PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Sprinklers.
4. Alarm devices.
5. Manual control stations.
6. Control panels.
7. Pressure gauges.

B. Related Sections:

1. Section 21 13 16 “Dry Pipe Sprinkler Systems”

1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

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

1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria obtained.

SECTION 21 13 13 –  
WET PIPE SPRINKLER SYSTEMS

- C. Sprinkler system design shall be approved by authorities having jurisdiction.
1. Margin of Safety for Available Water Flow and Pressure: **10** percent, including losses through water-service piping, valves, and backflow preventers.
  2. Minimum Density for Automatic-Sprinkler Piping Design:
    - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
    - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
    - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
  3. Maximum Protection Area per Sprinkler:
    - a. Office Spaces: 225 sq. ft..
    - b. Storage Areas: 130 sq. ft..
    - c. Mechanical Equipment Rooms: 130 sq. ft.
    - d. Electrical Equipment Rooms: 130 sq. ft.
    - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
  4. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
    - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
    - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Structural steel
  2. Domestic water piping.
  3. Compressed air piping.
  4. HVAC hydronic piping.
  5. Items penetrating finished ceiling include the following:
    - a. Lighting fixtures.

SECTION 21 13 13 –  
WET PIPE SPRINKLER SYSTEMS

- b. Air outlets and inlets.
  
  - E. Qualification Data: For qualified Installer and professional engineer.
  
  - F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
  
  - G. Welding certificates.
  
  - H. Perform fire-hydrant flow test report, record and submit the following information:
    - 1. Date
    - 2. Time
    - 3. Performed by
    - 4. Location of Residual Fire Hydrant R
    - 5. Location of Flow Fire Hydrant F
    - 6. Static Pressure at Residual Fire Hydrant R (psig)
    - 7. Measured Flow at Flow Fire Hydrant F (gpm)
    - 8. Residual Pressure at Residual Fire Hydrant R (psig)
  
  - I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
  
  - J. Field quality-control reports.
  
  - K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.
- 1.7 QUALITY ASSURANCE
- A. Installer Qualifications:
    - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
  
  - B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
  
  - 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. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
    - 1. NFPA 13, "Installation of Sprinkler Systems."

SECTION 21 13 13 –  
WET PIPE SPRINKLER SYSTEMS

1.8 COORDINATION

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

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 plain end.
- C. Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- D. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
- E. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME 16.1, Class 125.
- H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- J. Grooved-Joint, Steel-Pipe Appurtenances:

SECTION 21 13 13 –  
WET PIPE SPRINKLER SYSTEMS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International, Inc.
  - b. National Fittings, Inc.
  - c. Tyco Fire & Building Products LP.
  - d. Victaulic Company.
2. Pressure Rating: 175 psig minimum.
3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
  1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
  2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 SPECIALTY VALVES

- A. General Requirements:
  1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  2. Pressure Rating:
    - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
  3. Body Material: Cast or ductile iron.
  4. Size: Same as connected piping.
  5. End Connections: Flanged or grooved. Valves in first paragraph below are available in NPS 1-1/2 to NPS 8 (DN 40 to DN 200).
- B. Automatic (Ball Drip) Drain Valves:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

SECTION 21 13 13 –  
WET PIPE SPRINKLER SYSTEMS

- a. AFAC Inc.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
  3. Pressure Rating: 175 psig minimum.
  4. Type: Automatic draining, ball check.
  5. Size: NPS 1/2.
  6. End Connections: Threaded.

2.5 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International, Inc.
  - b. National Fittings, Inc.
  - c. Shurjoint Piping Products.
  - d. Tyco Fire & Building Products LP.
  - e. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AGF Manufacturing Inc.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. Tyco Fire & Building Products LP.
  - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

SECTION 21 13 13 –  
WET PIPE SPRINKLER SYSTEMS

C. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AGF Manufacturing Inc.
  - b. Triple R Specialty.
  - c. Tyco Fire & Building Products LP.
  - d. Victaulic Company.
  - e. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

2.6 SPRINKLERS

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

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire & Building Products LP.
3. Victaulic Company.
4. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Residential Applications: UL 1626.
4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating and as follows for specific situations(unless otherwise indicated or required by application):
  - a. Future Commercial Spaces – 8.0 K Upright.

D. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. White.

SECTION 21 13 13 –  
WET PIPE SPRINKLER SYSTEMS

4. Include (3) custom colors as indicated on drawings for concealed heads in ornamental ceiling areas.
- E. Special Coatings:
1. Wax.
  2. Lead.
  3. Corrosion-resistant paint.
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: white, 2 piece.
  2. Flush Mounting: white
- G. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Reliable Automatic Sprinkler Co., Inc.
    - b. Tyco Fire & Building Products LP.
    - c. Victaulic Company.
    - d. Viking Corporation.
  2. Standard: UL 199.
  3. Type: Wire cage with fastening device for attaching to sprinkler.

2.7 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Electrically Operated Alarm Bell:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Fire-Lite Alarms, Inc.; a Honeywell company.
    - b. Notifier; a Honeywell company.
    - c. Potter Electric Signal Company.
  2. Standard: UL 464.
  3. Type: Vibrating, metal alarm bell.
  4. Size: 6-inch minimum diameter.
  5. Finish: Red-enamel factory finish, suitable for outdoor use.
- C. Water-Flow Indicators:

SECTION 21 13 13 –  
WET PIPE SPRINKLER SYSTEMS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ADT Security Services, Inc.
  - b. McDonnell & Miller; ITT Industries.
  - c. Potter Electric Signal Company.
  - d. System Sensor; a Honeywell company.
  - e. Viking Corporation.
  - f. Watts Industries (Canada) Inc.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

D. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AFAC Inc.
  - b. Barksdale, Inc.
  - c. Detroit Switch, Inc.
  - d. Potter Electric Signal Company.
  - e. System Sensor; a Honeywell company.
  - f. Tyco Fire & Building Products LP.
  - g. United Electric Controls Co.
  - h. Viking Corporation.
2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

E. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fire-Lite Alarms, Inc.; a Honeywell company.
  - b. Kennedy Valve; a division of McWane, Inc.
  - c. Potter Electric Signal Company.
  - d. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.

SECTION 21 13 13 –  
WET PIPE SPRINKLER SYSTEMS

4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.8 PRESSURE GAUGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. AMETEK; U.S. Gauge Division.
  2. Ashcroft, Inc.
  3. Brecco Corporation.
  4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gauge Range: 0 to 250 psig minimum.
- E. Water System Piping Gauge: Include "WATER" label on dial face.

2.9 LISTED FIRE PROTECTION VALVES

- A. General Requirements:
  1. Valves shall be UL listed or FM approved.
  2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
- B. Ball Valves:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International, Inc.
    - b. NIBCO INC.
    - c. Victaulic Company.
  2. Standard: UL 1091 except with ball instead of disc.
  3. Port Size: Full
  4. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
  5. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
  6. Valves NPS 3: Ductile-iron body with grooved ends.
- C. Check Valves:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

SECTION 21 13 13 –  
WET PIPE SPRINKLER SYSTEMS

- a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. NIBCO INC.
  - c. Reliable Automatic Sprinkler Co., Inc.
  - d. Tyco Fire & Building Products LP.
  - e. Victaulic Company.
  - f. Viking Corporation.
  - g. Watts Water Technologies, Inc.
2. Standard: UL 312
  3. Pressure Rating: 250 psig minimum.
  4. Type: Swing check.
  5. Body Material: Ductile or Cast iron.
  6. End Connections: grooved.
  7. .
- D. Iron OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane Co.; Crane Valve Group; Crane Valves.
    - b. NIBCO INC.
    - c. Tyco Fire & Building Products LP.
    - d. Watts Water Technologies, Inc.
  2. Standard: UL 262.
  3. Pressure Rating: 250 psig minimum.
  4. Body Material: Cast or ductile iron.
  5. End Connections: Flanged or grooved.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 WATER-SUPPLY CONNECTIONS

- A. Install shutoff valve, alarm check valve, pressure gauge, drain, and other accessories indicated at connection to water-service piping.

SECTION 21 13 13 –  
WET PIPE SPRINKLER SYSTEMS

3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- I. Install alarm devices in piping systems.
- J. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- K. Install pressure gauges on riser or feed main, at each sprinkler test connection. Include pressure gauges with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing.
- L. Fill sprinkler system piping with water.
- M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

SECTION 21 13 13 –  
WET PIPE SPRINKLER SYSTEMS

3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. 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.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.5 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources

3.6 SPRINKLER INSTALLATION

SECTION 21 13 13 –  
WET PIPE SPRINKLER SYSTEMS

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

3.7 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 4. Energize circuits to electrical equipment and devices.
  - 5. Coordinate with fire-alarm tests. Operate as required.
  - 6. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.9 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.10 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.11 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

SECTION 21 13 13 –  
WET PIPE SPRINKLER SYSTEMS

- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
  - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  - 2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 1-1/2 to NPS 4, shall be one of the following:
  - 1. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  - 2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- E. Standard-pressure, wet-pipe sprinkler system, NPS 5 and larger, shall be one of the following:
  - 1. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  - 2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  - 3. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.12 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
  - 1. Rooms without Ceilings: Upright sprinklers unless otherwise indicated.
  - 2. Rooms with Suspended Ceilings: Semi-Recessed sprinklers unless otherwise indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
  - 1. Semi-Recessed Sprinklers: White, with white 2 piece escutcheon.
  - 2. Upright Sprinklers: Brass in finished and unfinished spaces.
  - 3. Concealed Pendent Sprinklers: White flat cover or custom colors as chosen by architect (3 total – 2 for wet and 1 for dry system).

END OF SECTION 21 13 13

SECTION 22 05 00 –  
COMMON WORK RESULTS FOR PLUMBING

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Transition fittings.
  - 3. Mechanical sleeve seals.
  - 4. Sleeves.
  - 5. Escutcheons.
  - 6. Grout.
  - 7. Plumbing demolition.
  - 8. Equipment installation requirements common to equipment sections.
  - 9. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, 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 chases.
- 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:

SECTION 22 05 00 –  
COMMON WORK RESULTS FOR PLUMBING

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.

#### 1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.

#### 1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Electrical Characteristics for Plumbing 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.

#### 1.6 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.

#### 1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

SECTION 22 05 00 –  
COMMON WORK RESULTS FOR PLUMBING

- B. Coordinate requirements for access panels and doors for plumbing 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

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

SECTION 22 05 00 –  
COMMON WORK RESULTS FOR PLUMBING

- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Solvent Cements for Joining Plastic Piping:
  - 1. ABS Piping: ASTM D 2235.
  - 2. CPVC Piping: ASTM F 493.
  - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 4. PVC to ABS Piping Transition: ASTM D 3138.
- F. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 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. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Dresser Industries, Inc.; DMD Div. c.  
JCM Industries.
    - d. Approved equal.
  - 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
  - 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
  - 4. Aboveground Pressure Piping: Pipe fitting.

2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc. b.  
Calpico, Inc.
    - c. Metraflex Co.
    - d. Approved equal.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

SECTION 22 05 00 –  
COMMON WORK RESULTS FOR PLUMBING

2.6 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends. B.  
PVC Pipe: ASTM D 1785, Schedule 40.

2.7 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, Floor-Plate Type: Cast-iron floor plate.

2.8 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.
  - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Division 1 Section 017300 Execution for "Cutting and Patching" and Division 2 Section 024119 "Selective 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.
  - 3. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner. Refer to General Conditions for scrap material recovery.

SECTION 22 05 00 –  
COMMON WORK RESULTS FOR PLUMBING

- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, notify Architect of damaged or unserviceable portions and provide cost proposal to replace with new products of equal capacity and quality.

3.2 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.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing. G.  
Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections. J.  
Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors. M.  
Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

SECTION 22 05 00 –  
COMMON WORK RESULTS FOR PLUMBING

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.
  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.
- Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 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.

SECTION 22 05 00 –  
COMMON WORK RESULTS FOR PLUMBING

- E. Brazed Joints: Construct joints according to AWS's "Braze 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. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
  - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
  - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- I. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- J. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- K. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End Pipe and Fittings: Use butt fusion.
  - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.4 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.

### 3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Structural drawings for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

END OF SECTION 22 05 00

22 05 53 –  
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment markers.
3. Equipment signs.
4. Access panel and door markers.
5. Pipe markers.
6. Stencils.
7. Valve tags.
8. Valve schedules.
9. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION

## IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

- 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 location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

## 2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
  - 1. Data:
    - a. Manufacturer, product name, model number, and serial number.
    - b. Capacity, operating and power characteristics, and essential data.
    - c. Labels of tested compliances.
  - 2. Location: Accessible and visible.
  - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
  - 1. Terminology: Match schedules as closely as possible.
  - 2. Data:
    - a. Name and plan number.
    - b. Equipment service.
    - c. Design capacity.
    - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
  - 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
  - 1. Data: Instructions for operation of equipment and for safety procedures.
  - 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
  - 3. Thickness: 1/16 inch for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.

## IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- D. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

## 2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME A13.1, unless otherwise indicated.
  2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
  3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
  4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
  5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
  2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

## 2.3 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.
1. Stencil Material: Metal or fiberboard.

## IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

2. Stencil Paint: Exterior, gloss, alkyd enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

## 2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect. Provide 5/32-inch hole for fastener.
  1. Material: 0.032-inch- thick brass.
  2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

## 2.5 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
  2. Frame: Finished hardwood.
  3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

## PART 3 - EXECUTION

## 3.1 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
  1. Fuel-burning units, including water heaters.
  2. Pumps.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
  1. Letter Size: Minimum 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

## IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
  3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
    - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    - b. Fire department hose valves and hose stations.
    - c. Meters, gages, thermometers, and similar units.
    - d. Fuel-burning units, including water heaters.
    - e. Pumps.
    - f. Tanks and pressure vessels.
    - g. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Letter Size: Minimum 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.
  2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
  3. Include signs for the following general categories of equipment:
    - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    - b. Fuel-burning units, including water heaters.
    - c. Pumps.
    - d. Tanks and pressure vessels.
    - e. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- D. Install access panel markers with screws on equipment access panels.

## 3.2 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.
  2. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.

## IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 nonaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

## 3.3 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of 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 similar to those indicated in the following:
1. Valve-Tag Size and Shape:
    - a. Cold Water: 1-1/2 inches, round.
    - b. Hot Water: 1-1/2 inches, round.
    - c. Fire Protection: 1-1/2 inches, round.
    - d. Gas: 1-1/2 inches, round.
  2. Valve-Tag Color:
    - a. Cold Water: Natural.
    - b. Hot Water: Natural.
    - c. Fire Protection: Natural.
    - d. Gas: Natural.
  3. Letter Color:
    - a. Cold Water: Black.
    - b. Hot Water: Black.
    - c. Fire Protection: Black.
    - d. Gas: Black.

## 3.4 VALVE-SCHEDULE INSTALLATION

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.6 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.7 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 22 05 53

SECTION 22 07 19 –  
PLUMBING PIPING INSULATION

SECTION 22 07 19 – PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.3 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
  - 2. Attachment and covering of heat trace inside insulation.
  - 3. Insulation application at pipe expansion joints for each type of insulation.
  - 4. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Removable insulation at piping specialties and equipment connections.
  - 6. Application of field-applied jackets.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE, AND HANDLING

SECTION 22 07 19 –  
PLUMBING PIPING INSULATION

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Plumbing Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for insulation application.
- C. Coordinate installation and testing of steam or electric heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Mineral-Fiber Insulation:
    - a. CertainTeed Manson.
    - b. Knauf FiberGlass GmbH.
    - c. Owens-Corning Fiberglas Corp.
  - 2. Flexible Elastomeric Thermal Insulation:
    - a. Armstrong World Industries, Inc.
    - b. Rubatex Corp.

2.2 INSULATION MATERIALS

- A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
  - 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
  - 2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:

SECTION 22 07 19 –  
PLUMBING PIPING INSULATION

- a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
  - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
- B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
- 1. Adhesive: As recommended by insulation material manufacturer.
  - 2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
- C. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

### 2.3 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..
- 1. Tape Width: 4 inches.
- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
- 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
  - 2. Galvanized Steel: 0.005 inch thick.
  - 3. Aluminum: 0.007 inch thick.
  - 4. Brass: 0.010 inch thick.
  - 5. Nickel-Copper Alloy: 0.005 inch thick.
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

SECTION 22 07 19 –  
PLUMBING PIPING INSULATION

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Apply multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.
- I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- J. Apply insulation with the least number of joints practical.
- K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
  - 1. Apply insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
  - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

SECTION 22 07 19 –  
PLUMBING PIPING INSULATION

- N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- O. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
  - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
  - 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
  - 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- P. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
  - 1. Seal penetrations with vapor-retarder mastic.
  - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
  - 3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal metal jacket to roof flashing with vapor-retarder mastic.
- Q. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
  - 1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
  - 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
  - 3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
  - 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:

SECTION 22 07 19 –  
PLUMBING PIPING INSULATION

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with standard PVC fitting covers.
4. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

D. Apply insulation to valves and specialties as follows:

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

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:

1. Apply pipe insulation to outer diameter of pipe flange.

SECTION 22 07 19 –  
PLUMBING PIPING INSULATION

2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the 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 the same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

C. Apply insulation to fittings and elbows as follows:

1. Apply mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

D. Apply insulation to valves and specialties as follows:

1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to stainer basket.
3. Apply insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

### 3.6 FINISHES

- A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 9 Section "Painting."
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the 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.

### 3.7 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
  1. Flexible connectors.
  2. Vibration-control devices.
  3. Fire-suppression piping.
  4. Drainage piping located in crawl spaces, unless otherwise indicated.

SECTION 22 07 19 –  
PLUMBING PIPING INSULATION

5. Below-grade piping, unless otherwise indicated.
6. Chrome-plated pipes and fittings, unless potential for personnel injury.
7. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.8 INSULATION APPLICATION SCHEDULE, GENERAL

- A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.
- B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

3.9 INTERIOR INSULATION APPLICATION SCHEDULE

- A. Service: Domestic hot and recirculated hot water.
  1. Operating Temperature: 60 to 140 deg F.
  2. Insulation Material: Mineral fiber.
  3. Insulation Thickness: Apply the following insulation thicknesses:
    - a. Copper Pipe, 2" and smaller: 1" thickness
    - b. Copper Pipe, 2-1/2" and larger: 1-1/2" thickness
    - c. Copper Pipe, Runouts in walls: 1/2" thickness Mineral fiber or Flexible elastomeric
  4. Field-Applied Jacket: None.
  5. Vapor Retarder Required: Yes.
  6. Finish: None.
- B. Service: Domestic water.
  1. Operating Temperature: 35 to 60 deg F.
  2. Insulation Material: Mineral fiber.
  3. Insulation Thickness: Apply the following insulation thicknesses:
    - a. All sizes: 1/2" thickness
    - b. Copper Pipe, Runouts in walls: 1/2" thickness Mineral fiber or Flexible elastomeric.
  4. Field-Applied Jacket: None.
  5. Vapor Retarder Required: Yes.
  6. Finish: None.
- C. Service: Roof drain bodies and horizontal Rain Water Leaders.
  1. Operating Temperature: 32 to 100 deg F.
  2. Insulation Material: Mineral fiber.
  3. Insulation Thickness: 1/2" thickness
  4. Field-Applied Jacket: None.
  5. Vapor Retarder Required: Yes.

SECTION 22 07 19 –  
PLUMBING PIPING INSULATION

6. Finish: None.

END OF SECTION 22 07 19

SECTION 22 11 16 –  
DOMESTIC WATER PIPING

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for water service.
- B. This Section includes domestic water piping from locations indicated to fixtures and equipment inside the building.
- C. See Section 22 05 00 Common Work Results for Plumbing.

1.3 SUBMITTALS

- A. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
  - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.

1.5 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

SECTION 22 11 16 –  
DOMESTIC WATER PIPING

2.1 INTERIOR PIPING MATERIALS

- A. Transition Couplings: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.
  - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought- copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
  - 3. 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.

2.2 INTERIOR VALVES

- A. Refer to Division 22 Section "Plumbing Valves" for bronze and cast-iron, general-duty valves.
- B. Refer to Division 22 Section "Plumbing Specialties" for balancing and drain valves.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- B. Interior Domestic Water Piping: Use the following piping materials for each size range:
  - 1. NPS 2 and Smaller: Hard copper tube, Type L; copper pressure fittings; and soldered joints.

3.2 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shutoff Duty: Use bronze ball valves for piping NPS 2 and smaller. Use cast-iron gate valves with flanged ends for piping NPS 2-1/2 and larger.
  - 2. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
  - 3. Drain Duty: Hose-end drain valves.

3.3 PIPING INSTALLATION

- A. Refer to Section 220500 Common Work Results for Plumbing for basic piping installation.
- B. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.

SECTION 22 11 16 –  
DOMESTIC WATER PIPING

- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each domestic water service.
- D. Install domestic water piping level without pitch and plumb.
- E. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- F. Perform the following steps before operation:
  - 1. Close drain valves, hydrants, and hose bibbs.
  - 2. Open shutoff valves to fully open position.
  - 3. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
  - 4. Remove and clean strainer screens. Close drain valves and replace drain plugs.
- G. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- H. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.4 JOINT CONSTRUCTION

- A. Refer to Section 220500 Common Work Results for Plumbing for basic piping joint construction.
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 VALVE INSTALLATION

- A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- B. Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
  - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
  - 2. Install stop-and-waste drain valves where indicated.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Refer to Section 220500 Common Work Results for Plumbing for pipe hanger and support devices.
- B. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.
- C. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

SECTION 22 11 16 –  
DOMESTIC WATER PIPING

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

D. Install supports for vertical copper tubing every 10 feet.

### 3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to service piping with shutoff valve, and extend and connect to the following:

1. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.8 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:

1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
  - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

B. Test domestic water piping as follows:

SECTION 22 11 16 –  
DOMESTIC WATER PIPING

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
  - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

END OF SECTION 22 11 16

SECTION 221123 –  
FACILITY NATURAL GAS PIPING

SECTION 221123 - FACILITY NATURAL GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Buildings: 0.5 psig or less.

C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

B. 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.

SECTION 221123 –  
FACILITY NATURAL GAS PIPING

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
  3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
    - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
- B. PE Pipe: ASTM D 2513, SDR 11.
1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
  2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
    - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering.
    - c. Aboveground Portion: PE transition fitting.
    - d. Outlet shall be threaded or suitable for welded connection.
    - e. Tracer wire connection.
    - f. Ultraviolet shield.
    - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
  4. Transition Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
    - b. Outlet shall be threaded or suitable for welded connection.
    - c. Bridging sleeve over mechanical coupling.
    - d. Factory-connected anode.
    - e. Tracer wire connection.
    - f. Ultraviolet shield.
    - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

SECTION 221123 –  
FACILITY NATURAL GAS PIPING

2.2 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 MANUAL GAS SHUTOFF VALVES

- A. See "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
  - 1. CWP Rating: 125 psig.
  - 2. Threaded Ends: Comply with ASME B1.20.1.
  - 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
  - 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
  - 6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
  - 1. CWP Rating: 125 psig.
  - 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
  - 3. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. Bronze Plug Valves: MSS SP-78.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Lee Brass Company.
    - b. McDonald, A. Y. Mfg. Co.
  - 2. Body: Bronze, complying with ASTM B 584.
  - 3. Plug: Bronze.
  - 4. Ends: Threaded, socket, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 5. Operator: Square head or lug type with tamperproof feature where indicated.
  - 6. Pressure Class: 125 psig.
  - 7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.

SECTION 221123 –  
FACILITY NATURAL GAS PIPING

8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.4 DIELECTRIC UNIONS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Capitol Manufacturing Company.
  - b. Central Plastics Company.
  - c. Hart Industries International, Inc.
  - d. Jomar International Ltd.
  - e. Matco-Norca, Inc.
  - f. McDonald, A. Y. Mfg. Co.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - h. Wilkins; a Zurn company.
2. Description:
  - a. Standard: ASSE 1079.
  - b. Pressure Rating: 125 psig minimum at 180 deg F.
  - c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.5 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade.
  1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.

SECTION 221123 –  
FACILITY NATURAL GAS PIPING

- D. Steel Piping with Protective Coating:
  - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
  - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
  - 3. Replace pipe having damaged PE coating with new pipe.
- E. Install fittings for changes in direction and branch connections.

3.2 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. 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.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
  - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and

SECTION 221123 –  
FACILITY NATURAL GAS PIPING

same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- Q. Connect branch piping from top or side of horizontal piping.
- R. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.
- S. Do not use natural-gas piping as grounding electrode.
- T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- U. Install sleeves for piping penetrations of walls, ceilings, and floors.
- V. Install sleeve seals for piping penetrations of concrete walls and slabs.
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors where exposed.

### 3.3 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.

### 3.4 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
  - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
  - 2. Cut threads full and clean using sharp dies.
  - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
  - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.

SECTION 221123 –  
FACILITY NATURAL GAS PIPING

5. 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.
- D. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
  2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Maximum spans below are from NFPA 54.
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.

3.6 LABELING AND IDENTIFYING

- A. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.7 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.8 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be one of the following:
1. PE pipe and fittings joined by heat fusion; service-line risers with tracer wire terminated in an accessible location.
  2. Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- B. Aboveground natural-gas piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.

SECTION 221123 –  
FACILITY NATURAL GAS PIPING

2. Steel pipe with wrought-steel fittings and welded joints.

3.9 INDOOR PIPING SCHEDULE

- A. Aboveground, distribution piping shall be one of the following:
  1. Steel pipe with malleable-iron fittings and threaded joints.
  2. Steel pipe with wrought-steel fittings and welded joints.

3.10 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be the following:
  1. Cast-iron, non-lubricated plug valve.
- B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:
  1. Bronze plug valve.
- C. Valves in branch piping for single appliance shall be the following:
  1. Bronze plug valve.

END OF SECTION 22 11 23

SECTION 22 13 16 –  
SANITARY WASTE AND VENT PIPING

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

- A. The following are industry abbreviations for rubber piping materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer.
  - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 PERFORMANCE REQUIREMENTS

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

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

SECTION 22 13 16 –  
SANITARY WASTE AND VENT PIPING

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
  - 1. Gaskets: ASTM C 564, rubber.
- B. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
  - 1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
    - a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
    - b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
- C. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
  - 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought-copper, solder-joint fittings.
- D. Solid-Wall Cellular-Core PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
  - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
  - 2. Solvent Cement and Adhesive Primer:
    - a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
  - 1. Gaskets: ASTM C 564, rubber.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

SECTION 22 13 16 –  
SANITARY WASTE AND VENT PIPING

3.2 PIPING APPLICATIONS

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- C. Aboveground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
  - 1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
  - 2. Hubless cast-iron soil pipe and fittings standard, shielded, stainless-steel couplings; and hubless-coupling joints.
  - 3. Copper DWV tube, copper drainage fittings, and soldered joints.
  - 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Underground, soil, waste, and vent piping NPS 6 and smaller shall be any of the following:
  - 1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
  - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.3 PIPING INSTALLATION

- A. Refer to Section 220500 Common Work Results for Plumbing for basic piping installation.
- B. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- C. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- D. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- E. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- F. Install engineered soil and waste drainage and vent piping systems in locations indicated and as follows:

SECTION 22 13 16 –  
SANITARY WASTE AND VENT PIPING

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
  2. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- G. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- H. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

- A. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
  2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 VALVE INSTALLATION

- A. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
1. Use gate or full-port ball valve for piping NPS 2 and smaller.
  2. Use gate valve for piping NPS 2-1/2 and larger.
- B. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Support vertical piping and tubing at base and at each floor.
- B. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- C. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  2. NPS 3: 60 inches with 1/2-inch rod.
  3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  4. NPS 6: 60 inches with 3/4-inch rod.

SECTION 22 13 16 –  
SANITARY WASTE AND VENT PIPING

5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- D. Install supports for vertical cast-iron soil piping every 15 feet.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  1. NPS 1-1/4: 72 inches with 3/8-inch rod.
  2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  3. NPS 2-1/2: 108 inches with 1/2-inch rod.
  4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
  5. NPS 6: 10 feet with 5/8-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.
- H. Install vinyl-coated hangers for glass piping with the following maximum horizontal spacing and minimum rod diameters:
  1. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  3. NPS 3: 96 inches with 1/2-inch rod.
  4. NPS 4 and NPS 6: 96 inches with 5/8-inch rod.
  5. NPS 8 and NPS 12: 96 inches with 3/4-inch rod.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
  1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
  2. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

SECTION 22 13 16 –  
SANITARY WASTE AND VENT PIPING

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
  - C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
  - D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
    1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
    2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
    3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
    4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
    5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
    6. Prepare reports for tests and required corrective action.

3.9 CLEANING

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

3.10 PROTECTION

- A. Exposed Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 22 13 16

SECTION 22 14 13 –  
FACILITY STORM DRAINAGE PIPING

SECTION 22 14 13 – FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes storm-drainage piping inside the building.
- B. Related Sections include the following:
  - 1. Section 22 07 19 "Plumbing Piping Insulation" for storm drainage piping system insulation.

1.3 DEFINITIONS

- A. The following are industry abbreviations for plastic piping materials:
  - 1. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

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

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

SECTION 22 14 13 –  
FACILITY STORM DRAINAGE PIPING

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Flexible Transition Couplings for Underground Nonpressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.
- C. Transition Couplings for Underground Pressure Piping: AWWA C219 metal, sleeve-type coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ANACO-Husky.
    - b. Fernco Inc.
    - c. Matco-Norca, Inc.
    - d. MIFAB, Inc.
    - e. Mission Rubber Company; a division of MCP Industries, Inc.
    - f. Tyler Pipe.
  - 2. Standards: ASTM C 1277 and CISPI 310.
  - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ANACO-Husky.
  - b. Clamp-All Corp.
  - c. MIFAB, Inc.
  - d. Mission Rubber Company; a division of MCP Industries, Inc.
  - e. Tyler Pipe.
- 2. Standards: ASTM C 1277 and ASTM C 1540.

SECTION 22 14 13 –  
FACILITY STORM DRAINAGE PIPING

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F 656.
  1. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Solvent Cement: ASTM D 2564.
  1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. 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.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.

SECTION 22 14 13 –  
FACILITY STORM DRAINAGE PIPING

- H. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- I. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- J. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- K. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Storm Drain: 2 percent downward in direction of flow for piping.
  - 2. Horizontal Storm-Drainage Piping: 1 percent downward in direction of flow.
- L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- M. Install aboveground PVC piping according to ASTM D 2665.
- N. Install underground and PVC piping according to ASTM D 2321.
- O. Plumbing Specialties:
  - 1. Install backwater valves in storm drainage gravity-flow piping. Comply with requirements for backwater valves specified in Division 22 Section "Storm Drainage Piping Specialties."
  - 2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 Section "Storm Drainage Piping Specialties."
  - 3. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Storm Drainage Piping Specialties."
- P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

SECTION 22 14 13 –  
FACILITY STORM DRAINAGE PIPING

3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasketed joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- D. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in OD's.
  - 2. In Drainage Piping: Unshielded, nonpressure transition couplings.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 4. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

SECTION 22 14 13 –  
FACILITY STORM DRAINAGE PIPING

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.

J. Install supports for vertical PVC piping every 48 inches.

K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

SECTION 22 14 13 –  
FACILITY STORM DRAINAGE PIPING

3.7 IDENTIFICATION

- A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
  - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 5. Prepare reports for tests and required corrective action.

3.9 CLEANING

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

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

SECTION 22 14 13 –  
FACILITY STORM DRAINAGE PIPING

- B. Aboveground storm drainage piping NPS 8 and smaller shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
  3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- C. Underground storm drainage piping NPS 8 and smaller shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.
  3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 22 14 13

SECTION 22 41 00 –  
PLUMBING FIXTURES

SECTION 22 41 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes plumbing fixtures and related components.

1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

1.4 SUBMITTALS

- A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For plumbing fixtures to include in maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
  - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

SECTION 22 41 00 –  
PLUMBING FIXTURES

- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; about plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.
- E. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- F. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- H. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
  - 1. Hand Sinks: NSF 2 construction.
  - 2. Plastic Mop-Service Basins: ANSI Z124.6.
  - 3. Stainless-Steel Fixtures Other Than Service Sinks: ASME A112.19.3M.
  - 4. Vitreous-China Fixtures: ASME A112.19.2M.
  - 5. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
  - 6. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- I. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
  - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
  - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
  - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
  - 4. Faucet Hose: ASTM D 3901.
  - 5. Faucets: ASME A112.18.1M.
  - 6. Hose-Connection Vacuum Breakers: ASSE 1011.
  - 7. Hose-Coupling Threads: ASME B1.20.7.
  - 8. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
  - 9. NSF Materials: NSF 61.
  - 10. Pipe Threads: ASME B1.20.1.
  - 11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
  - 12. Supply and Drain Fittings: ASME A112.18.1M.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
  - 1. Atmospheric Vacuum Breakers: ASSE 1001.
  - 2. Brass and Copper Supplies: ASME A112.18.1M.
  - 3. Manual-Operation Flushometers: ASSE 1037.
  - 4. Tubular Brass Drainage Fittings and Piping: ASME A112.18.1M.
- K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

SECTION 22 41 00 –  
PLUMBING FIXTURES

1. Disposers: ASSE 1008 and UL 430.
2. Floor Drains: ASME A112.21.1M.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Off-Floor Fixture Supports: ASME A112.6.1M.
5. Pipe Threads: ASME B1.20.1.
6. Plastic Toilet Seats: ANSI Z124.5.
7. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 COORDINATION

- A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers listed or approved equal.

2.2 TANK TYPE WATER CLOSET - FLOOR MOUNTED (WC-1)

- A. Available Manufacturers:
  1. American Standard Plumbing
  2. Kohler Co.
  3. Mansfield.
  4. Sloan Valve Co.
- B. Bowl: ASME A112.19.2, 1.28GPF, floor mounted, high efficiency ultra-low consumption, EPA Water Sense, vitreous china closet bowl, with elongated, mold/odor/stain resistant surfaces, close-couple flushometer tank, (confirm right or left hand lever with plans), china bolt caps. **American Standard “Colony Right Height” – model 751AA.101.**
- C. Seat & Cover: Quiet close solid white plastic, extended back, brass bolts, slow-close.

2.3 SHOWER (SH-1)

- A. Manufacturers:
  1. American Standard Plumbing.
  2. Eljer Plumbingware.
  3. Kohler Co.
  4. Mansfield.

SECTION 22 41 00 –  
PLUMBING FIXTURES

- B. ANSI CSA B45.5-11/IAMPO Z124, 60"x30"x18". Barrier free shower pan, reinforced solid surface, , end drain outlet (\*confirm right or left end with plans), slip resistant textured floor. **Swanstone - model #SBF-3060(L/R)** - confirm left or right side drains with floor plans.
- C. Accessories:
  - 1. P-trap, perforated open strainer.
- D. Trim kit with pressure balanced cartridge: 1.8gpm, American Standard ‘Delancey’ model **TU052508.013** – polished nickel finish.

#### 2.4 TUB & SHOWER (T-1)

- A. Manufacturers:
  - 1. American Standard Plumbing.
  - 2. Eljer Plumbingware.
  - 3. Kohler Co.
  - 4. Mansfield.
- B. ANSI CSA B45.5-11/IAMPO Z124, 60"x30"x18". high-gloss acrylic with fiberglass reinforcement, integral apron, end drain outlet (\*confirm right or left end with plans), slip resistant textured floor, three-sided 1” tiling flange. **American Standard - Studio model #2573\*02.** \* - confirm left and right side drains with floor plans.
- C. Accessories:
  - 1. P-trap, perforated open strainer.
- D. Trim kit with pressure balanced cartridge: 1.8gpm, American Standard ‘Delancey’ model **TU052508.013** – polished nickel finish.

#### 2.5 SINK (S-1)

- A. Manufacturers:
  - 1. American Standard Plumbing.
  - 2. Elkay / Dayton.
  - 3. Kohler Co.
  - 4. Sloan Valve Co.
- A. Single-bowl 18ga. Stainless Steel undermount sink: ASME A112.19.3; 33” x 22” x 9”deep, 1 hole. **American Standard “Edgewater” model 18SB.9332211.075.**
- B. Faucet: single lever, ADA compliant, 1.5 gpm aerator, swivel spout with pull-down dual spray function. **American Standard ‘Delancey’ model 4279300.075** - finish stainless steel.
- C. Accessories:
  - 1. Chrome plated 17 gage brass P-trap and arm with escutcheon.
  - 2. Offset waste with perforated open strainer.

#### 2.6 SINK (S-2)

SECTION 22 41 00 –  
PLUMBING FIXTURES

- A. Manufacturers:
  - 1. American Standard Plumbing.
  - 2. Eljer Plumbingware.
  - 3. Kohler Co.
  - 4. Sloan Valve Co.
  
- B. Vitreous China undermount sink: ASME A112.19.2M; ADA, 19-3/4" x 13-3/4" x 6-1/4" deep vitreous china, front concealed overflow, 3 faucet holes, 4" centers. **American Standard "Studio" model 0614.000.**
  
- C. Faucet: Two handle, 3 hole, 4" centers, 1.2gpm, pop-up drain, ADA, American Standard 'Delancey' model 7052807002 – polished chrome.
  
- D. Accessories:
  - 1. Chrome plated 17 gage brass P-trap and arm with escutcheon.
  - 2. Offset waste with perforated open strainer.
  - 3. Wheel handle stops.
  - 4. Flexible supplies.
  - 5. Wheel handle stops.
  - 6. Flexible supplies.

**2.7 SINK (S-3)**

- A. Vitreous china wall mounted lavatory: Drilled for concealed arm carrier, single faucet hole, less overflow; **American Standard "Lucerne" model 0356.**
  
- B. Metered Faucet: chrome plated, self-closing metered faucet with adjustable time cycle, ADA compliant push to operate, 0.5 gpm, **American Standard model 1340.109.**
  
- C. Undersink Pipe Cover: Truebro Inc. or approved equal.
  - 1. Pipe Cover: ADA conforming, wheelchair accessible lavatory P-trap and angle valve assemblies shall be covered with a molded, antimicrobial Lav-Guard undersink protective pipe cover. Cover shall be secured with reusable fasteners. Color shall be as selected by the Architect.
  
- D. Accessories:
  - 1. Chrome plated 17 gage brass P-trap and arm with escutcheon.
  - 2. Offset waste with perforated open strainer.
  - 3. Wheel handle stops.
  - 4. Rigid supplies.

**2.8 MOP SINK (MS-1)**

- A. Manufacturers:
  - 1. Fiat Products Model TSB3011.
  
- B. Basin: Molded Stone, one piece homogeneous, 32" x 32" x 12" deep, drop front, stainless threshold.
  
- C. Drain Body: Stainless steel cast integral and shall provide for a caulked lead connection of not less than 1" deep to a 3" pipe.

SECTION 22 41 00 –  
PLUMBING FIXTURES

- D. Service Faucet: Fiat model 830-AA Chrome plated with vacuum breaker, integral stops, adjustable wall brace, pail hook and  $\frac{3}{4}$ " hose thread on spout.
  - 1. Hose and bracket: Fiat model 832-AA.
  - 2. Mop hanger: Fiat model 889-CC.
  - 3. Silicone sealant: Fiat model 833-AA.
  - 4. Aluminum bumperguard with vinyl insert: Fiat model 1239-BB.

**2.9 GARBAGE DISPOSERS**

- A. Insinkerator Evolution series, 1HP, auto-reverse, stainless steel chamber and components, and sound reduction features.
- B. Provide for all apartment units.

**2.10 OTHER ITEMS**

- A. Water Hammer Arrestors:
  - 1. Apartments and pipe sizes up to  $\frac{3}{4}$ ": Watts model LF05 or equal.
  - 2. Commercial areas, pipe sizes  $\frac{3}{4}$ " and larger: Watts model LF15M2.
- B. Non-Freeze Wall Hydrant: Watts model HY-420 or approved equal.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 FIXTURE INSTALLATION**

- A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install kitchen area fixtures furnished by others. Verify exact locations with the Architect and coordinate faucets, accessories and rough-in accordingly.
- C. Install relocated sinks and faucets from existing Sacristy. Verify exact locations with the Architect and coordinate faucets, accessories and rough-in accordingly.

SECTION 22 41 00 –  
PLUMBING FIXTURES

- D. For wall-hanging fixtures, install off-floor supports affixed to building substrate.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- E. Install back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.
- F. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- G. Install wall-hanging fixtures with tubular waste piping attached to supports.
- H. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- I. Install counter-mounting fixtures in and attached to casework.
- J. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- K. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  - 1. Exception: Use ball, gate, or globe valve if stops are not specified with fixture.
- L. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- M. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- N. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- O. Install toilet seats on water closets.
- P. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- Q. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
- R. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- S. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
  - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- T. Install disposer in outlet of sinks indicated to have disposer. Electrical Contractor to install switch where indicated or in wall adjacent to sink if location is not indicated.

SECTION 22 41 00 –  
PLUMBING FIXTURES

- U. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Section "Basic Mechanical Materials and Methods" for escutcheons.
- V. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Section "Joint Sealants" for sealant and installation requirements.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect drain piping from fixtures to drainage piping.
- D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.
- E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
- F. Ground equipment.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed.
- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust disposers and controls. Replace damaged and malfunctioning units and controls.

SECTION 22 41 00 –  
PLUMBING FIXTURES

- C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- D. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
  - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
  - 2. Remove sediment and debris from drains.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 41 00

SECTION 23 05 00 –  
COMMON WORK RESULTS FOR HVAC

SECTION 23 05 00 – COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The intent of the Division 23 specifications and the accompanying drawings is to provide complete and workable systems as shown, specified and required by applicable codes. Include all work specified in Division 23 and shown on the accompanying drawings.
- B. The drawings that accompany the Division 23 specifications are diagrammatic. They do not show every offset, bend, tee, or elbow which may be required to install work in the space provided and avoid conflicts. Follow the drawings as closely as is practical to do so and install additional bends, offsets and elbows where required by local conditions from measurements taken at the building, subject to approval, and without additional cost to the contract.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 017329, Cutting and Patching
- B. Section 019100, General Commissioning Requirements
- C. Section 024113, Site Demolition
- D. Section 078400, Firestopping
- E. Section 083100, Access Doors and Panels
- F. Section 099100, Painting

1.3 REFERENCES

- A. NEMA: National Electrical Manufacturers Association
  - 1. NEMA MG1: Motors and Generators

1.4 QUALITY ASSURANCE

- A. Materials and equipment shall be new. Work shall be of good quality, free of faults and defects.
- B. All equipment shall fit in the space provided.

SECTION 23 05 00 –  
COMMON WORK RESULTS FOR HVAC

- C. Systems shall be built and installed to deliver their full rated capacity at the efficiency for which they were designed.
- D. Systems shall operate at full capacity without objectionable noise or vibration.
- E. Materials and Equipment:
  - 1. Each piece of equipment provided shall meet all detailed requirements of the drawings and specifications and shall be suitable for the installation shown.
  - 2. Where two or more units of the same class of equipment are provided, use products of the same manufacturer; component parts of the entire system need not be products of the same manufacturer.
- F. Workmanship:
  - 1. Install all materials in a neat and workmanlike manner.
  - 2. Follow manufacturer's directions. If they are in conflict with the contract documents, obtain clarification before starting work.
- G. Cutting and Patching:
  - 1. Cutting, patching and repairing for the proper installation and completion of the work specified in this division, including plastering, masonry work, concrete work, carpentry work, firestopping, and painting, shall be performed by skilled craftsmen of each respective trade in conformance with the appropriate division of work. Additional openings required in building construction shall be made by drilling or cutting.
  - 2. Fill holes which are cut oversize so that a tight fit is obtained around the objects passing through.
  - 3. Do not pierce beams or columns without permission of the Port and then only as directed.
  - 4. New or existing work that is cut or damaged shall be restored to its original condition. Where alterations disturb existing finishes, the surfaces shall be repaired, refinished and left in condition existing prior to commencement of work.

1.5 SUBMITTALS

- A. General:
  - 1. Comply with the requirements of Section 013300, Submittal Procedures, and the additional requirements specified herein.
- B. Shop Drawings:
  - 1. The contract drawings indicate the general layout of the piping, ductwork and various items of equipment. Coordination with other trades and with field conditions is required. For this purpose, submit shop drawings of all installations not detailed on the contract drawings, and of all changes to the contract drawings.
  - 2. Shop drawings shall be new drawings prepared by the Contractor and shall not be reproductions or tracings of the contract drawings. Overlay drawings with shop drawings of other trades and check for conflicts. Shop drawings shall be the same size as the contract drawings with title blocks similar to the contract drawings. Shop drawings shall identify the related contract drawing number or related reference drawing. Shop

SECTION 23 05 00 –  
COMMON WORK RESULTS FOR HVAC

drawings shall be fully dimensioned, including both plan and elevation dimensions. Do not use shop drawings to make scope changes.

3. Shop drawings shall include but not be limited to:
  - a. Complete floor plans with sheet metal and mechanical piping to a minimum of 1/8" = 1'-0" scale.
  - b. HVAC Sheet metal and mechanical piping of mechanical and fan rooms to a minimum of 1/4" = 1'-0" scale.
  - c. Sections of congested areas to a minimum of 1/4" = 1'-0" scale.
  - d. Fabricated equipment to a minimum of 1/4" = 1'-0" scale.
  - e. Controls and instrumentation to scale and drawing sizes to suit controls supplier.
4. Submit shop drawings for review as required by the contract documents. Additional shop drawings may be requested when it appears that coordination issues are not being resolved in the field, or when there is a question as to whether contract documents are being complied with or the design intent is being met.

C. Product Data:

1. Submit product data for review on all scheduled pieces of equipment, equipment requiring electrical connections or connections by other trades, and as required by the contract documents. Include manufacturer's detailed shop drawings, specifications, and data sheets. Data sheets shall include capacities, RPM, BHP, pressure drop, design and operating pressures, temperatures and similar data. Manufacturer's abbreviations or codes are not acceptable.
2. List the name of the motor manufacturer and service factor for each piece of equipment.
3. Indicate equipment operating weights including bases and weight distribution at support points.
4. In the case of equipment specified by specific catalog number, such as wiring devices, time switches, valves, etc., a statement of conformance will suffice.

D. Operation and Maintenance Data:

1. Submit operation and maintenance data for review on all scheduled pieces of equipment, and as required by the contract documents.

E. Commissioning Documentation:

1. Submit commissioning plans, schedules, and related documentation in accordance with the contract documents.

1.6 PROVISIONS FOR LARGE EQUIPMENT

- A. Make provisions for the necessary openings in the building to allow for admittance of all equipment.

SECTION 23 05 00 –  
COMMON WORK RESULTS FOR HVAC

1.7 PROJECT CONDITIONS

- A. Coordinate exact requirements governed by actual job conditions. Check all information and report any discrepancies before fabricating work. Report changes in time to avoid unnecessary work.

PART 2 - PRODUCTS

2.1 ACCESS PANELS

- A. Comply with the requirements of Section 083100, Access Doors and Panels.
- B. Access panels shall be 18 inches by 18 inches in ceilings, soffits, and shafts, and 12 inches by 12 inches in walls, unless indicated otherwise.
- C. Provide access panels where indicated and where required to access valves, fire/smoke dampers, balancing dampers, and other appurtenances requiring operation, service, or maintenance. Review locations prior to installation.

2.2 PIPE AND DUCT SLEEVES

- A. Interior Wall and Floor Sleeves: 18 gauge galvanized steel.
- B. Exterior Wall Sleeves: Cast iron.
- C. On-Grade Floor Sleeves: Cast iron.

2.3 FLOOR, WALL, AND CEILING PLATES

- A. Provide stamped split-type plates as follows:
  - 1. Floor Plates: Cast brass, chromium plated.
  - 2. Wall and Ceiling Plates: Spun aluminum.

2.4 SEALANT

- A. General Purpose: Tremco Dymeric Sealant, or equal.
- B. Floor Penetration Sealant: Hydroment Ultra-Set Sealant by Bostik, Inc., or pre-bid approved equal.
- C. Firestop Sealant: See Section 078400, Firestopping.

SECTION 23 05 00 –  
COMMON WORK RESULTS FOR HVAC

2.5 MACHINERY GUARDS

- A. Provide guards for protection on all rotating and moving parts of equipment. Provide guards for all metal fan drives and motor pulleys, even if they are enclosed in a metal cabinet.
- B. Design guards so they do not restrict air flow at fan inlets resulting in reduced capacity.
- C. Provide shaft holes in guards for easy use of tachometers at pulley centers. Guards shall be easily removable for pulley adjustment or for removal and changing of belts.
- D. All guards shall meet OSHA requirements including back plates.
- E. Provide inlet and outlet screens on all fans in plenums or where exposed to personnel.

2.6 ELECTRICAL EQUIPMENT

- A. General: All equipment and installed work shall be as specified under Division 26, Electrical.
- B. Motors:
  - 1. Motors shall be furnished as integral part of driven equipment. They shall be completely enclosed, fan cooled induction type with sealed ball bearings. Motors 1 hp and above shall be NEMA Premium Efficiency type except for emergency equipment motors. Motors shall be built to NEMA standards for the service intended. The motors shall be rated for the voltage specified, suitable for operation within the range of 10 percent above to 10 percent below the specified voltage. Energy efficient motors shall be Century E-plus, Baldor Super E, Westinghouse Life Line, General Electric Energy Saver, Toshiba, or equal.
  - 2. Motors shall be designed for a synchronous speed of 1800 rpm unless scheduled otherwise.
  - 3. Motors 1/2 hp and Larger: 3-phase, 60 cycle, 460V, service factor of 1.15, unless specifically noted otherwise.
  - 4. Motors 1/3 hp and Below: 1-phase, 60 cycle ac, 115V unless specifically noted otherwise, complete with integral thermal protection.
  - 5. Provide motors on belt drive equipment of nominal nameplate horsepower with not less than 120 percent of equipment brake horsepower required for performance specified.
  - 6. Motors shall have built-in thermal overload protection, or be protected externally with separate thermal overload devices with low-voltage release or lockout. Hermetically sealed motors shall have quick trip devices.
  - 7. Motors controlled by variable speed drives shall be inverter duty rated and shall have Class F insulation or better. They shall be able to withstand repeated voltage peaks of 1600 volts with rise times of 0.1 microseconds and greater, in accordance with NEMA Standard MG1, Part 31.
  - 8. Life expectancy of bearings shall exceed 100,000 hours of direct couple and 40,000 hours with belt.

SECTION 23 05 00 –  
COMMON WORK RESULTS FOR HVAC

9. Motors served from variable frequency drives shall be equipped with a shaft grounding system utilizing brush grounding kits to provide a path for current to flow between the shaft and the motor frame.
  10. Frequency drive manufacturers shall provide necessary filters and line reactor type equipment to protect motors from excessive voltage spikes that may exceed insulation requirements of NEMA MG1, Part 31. Use SGS, or equal.
  11. For motors 20 hp and greater, submit the following supplemental data:
    - a. Number of stator slots.
    - b. Number of rotor bars.
    - c. Load current.
    - d. Stator resistance.
    - e. Stator configuration delta or wye.
    - f. Bearing manufacturer and part numbers.
  12. Motors shall have a three year warranty.
- C. Starters: See Division 26, Electrical. Starters shall be suitable for performing the control functions required, with the exception of self-contained equipment and where the starters are furnished as part of the control package.
- D. Equipment Wiring: Interconnecting wiring within or on a piece of mechanical equipment shall be provided with the equipment unless shown otherwise. This does not include the wiring of motors, starters and controllers specified in Division 26, Electrical.

PART 3 - EXECUTION

3.1 DEMOLITION AND SALVAGE

- A. Remove or relocate ductwork, piping, control wiring, devices and equipment encountered in existing areas affected by this work as indicated on the drawings. Status of items not indicated for demolition on the drawings shall be verified with the Port.

3.2 SYSTEM WATER DISPOSAL

- A. Do not drain water from systems treated with chemicals, such as heating hot water, chilled water, and stem systems, into the sanitary or storm sewers without written approval from the Port.

3.3 ACCESS PANELS

- A. Install in accordance with manufacturer's recommendations, coordinated with architectural features. Review intended locations with the Port prior to installation.

SECTION 23 05 00 –  
COMMON WORK RESULTS FOR HVAC

3.4 SLEEVES

- A. General:
  - 1. Lay out work prior to concrete forming. Do all cutting and patching required. Reinforce sleeves to prevent collapse during forming and pouring.
  - 2. All core-drilled penetrations shall be sleeved, unless detailed otherwise on the drawings.
  - 3. Sleeves shall be large enough to allow 3/4-inch clearance around pipe. When pipe is insulated, insulation shall pass continuously through sleeve with 3/4-inch clearance between insulation and sleeve.
- B. Interior Wall Sleeves:
  - 1. Pack with fiberglass insulation.
  - 2. Terminate sleeve flush with face of wall unless indicated otherwise.
- C. Below-Grade Exterior Wall Sleeves: Sleeves shall be large enough to allow for caulking and made watertight. Caulk from outside using link-seal modular wall and casing seal or lead and oakum. Secure sleeves against displacement.
- D. Above-Grade Exterior Wall Sleeves: Similar to interior wall sleeves, except caulk outside with sealant.
- E. Sleeves Through Floors:
  - 1. Floor sleeves shall extend 1 1/2 inch above finished floor, except waste stacks using carriers shall have sleeve flush with floor.
  - 2. Do not support pipes by resting pipe clamps on floor sleeves. Provide supplementary members so pipes are floor-supported.
  - 3. Penetrations shall be made watertight by sealing gap between sleeve and the floor with floor penetration sealant as specified in Part 2.
- F. Sleeves Through Fire-Rated Floors:
  - 1. Install the same as sleeves through floors, except:
    - a. Make penetrations through floor watertight by sealing gap between sleeve and floor with floor penetration sealant as specified in Part 2, and
    - b. Provide firestopping system both inside and outside of sleeve as specified in Section 078400, Firestopping, and in accordance with the best practice recommendations of the Port's insurance underwriter, FM Global.
- G. Sleeves Through Fire-Rated Walls:
  - 1. Provide firestopping system as specified in Section 078400, Firestopping, and in accordance with the best practice recommendations of the Port's insurance underwriter, FM Global.
- H. On-Grade Floor Sleeves: Same as for below-grade exterior wall sleeves, except caulked from inside.
- I. Sleeves Through Roof: Extend 8 inches above roof.

SECTION 23 05 00 –  
COMMON WORK RESULTS FOR HVAC

- J. Sleeves specified or indicated at fire/smoke damper penetrations shall take precedence over this article.

3.5 FIRESTOPPING

- A. Comply with the requirements of Section 078400, Firestopping.
- B. Provide fire-rated assemblies at all penetrations of 1 hour or more.

3.6 CLEANING

- A. Clean HVAC equipment, piping and ductwork of stampings and markings (except those required by codes), iron cuttings, and other refuse.
- B. Clean scratched or marred painted surfaces of rust or other foreign matter and paint with matching color industrial enamel, except as otherwise noted.

3.7 EQUIPMENT PROTECTION

- A. Keep HVAC pipe, ductwork and conduit openings closed by means of plugs or caps to prevent the entrance of foreign matter. Protect HVAC piping, conduit, ductwork, and equipment against dirty water, chemical, or mechanical damage both before and after installation. Restore damaged or contaminated piping, conduit, and equipment to original conditions or replace at no added cost to the contract.
- B. Protect bright finished shafts, bearing housings, and similar items until in service. No rust will be permitted.
- C. Cover or otherwise suitably protect equipment and materials stored on the job site.
- D. Provide filters at all openings in operating systems on return or exhaust ductwork.

3.8 ACCESSIBILITY

- A. Conveniently locate variable and constant volume boxes, control panels, hardware and devices, valves, thermometers, gauges, and other equipment or specialties requiring frequent reading, adjustments, inspection, repairs, or removal and replacement.
- B. Install thermometers and gauges to be easily read from floors, platforms, and walkways.
- C. Provide 36 inches clear access space on each side of variable and constant volume terminal units containing control valves, actuators, electrical disconnect, and DDC controls. Coordinate with other trades the locating of light fixtures, fire sprinkler piping, as well as other equipment, piping, and conduit to avoid obstructing access to serviceable components of terminal units.

SECTION 23 05 00 –  
COMMON WORK RESULTS FOR HVAC

Provide access panels in linear metal, wood slat, gypsum board, or other hard ceilings to permit convenient access to terminal units.

- D. Provide access panels in linear metal, wood slat, gypsum board, or other hard ceilings and walls to permit convenient access to fire/smoke dampers, and isolation, emergency shut-off, and other valves.

3.9 FLOOR, WALL AND CEILING PLATES

- A. Install plates on HVAC piping and ductwork passing through finished walls, floors, ceilings, partitions and plaster furrings. Plates shall completely cover opening around pipe and duct.
- B. Secure wall and ceiling plates to pipe, insulation, or structure.
- C. Plates shall not penetrate insulation vapor barriers.
- D. Plates are not required in mechanical rooms or unfinished spaces.

3.10 ELECTRICAL EQUIPMENT

- A. No piping, ducts, leak protection apparatus, or other equipment foreign to the electrical installation shall be located in the dedicated electrical space around electrical equipment.
- B. The area above the dedicated electrical space shall be permitted to contain foreign systems, provided protection is installed to avoid damage to the electrical equipment from condensation, leaks, or breaks in such foreign systems.
- C. Unions in mechanical piping shall not be installed in dedicated electrical or IT spaces, or above or below ceilings.
- D. Low point drains in mechanical piping shall not be installed in dedicated electrical or IT spaces, or above or below ceilings. If this cannot be avoided, the low point drain connection shall be extended outside of the electrical or IT space.
- E. Outdoor electrical equipment shall be protected from accidental spillage or leakage from piping systems.

3.11 EQUIPMENT CONNECTIONS

- A. Make final connections to equipment in accordance with manufacturer's instructions, shop drawings, and as indicated.
- B. Piping:
  - 1. Connections shall include heating hot water, chilled water, steam supply, steam vent and condensate.

SECTION 23 05 00 –  
COMMON WORK RESULTS FOR HVAC

2. Provide easily accessible unions and gate valves in all piping at equipment, steam drip trap assemblies, and any other fittings required for complete installation.
3. Piping connections shall be independently supported to prevent undue strain on equipment.

3.12 PAINTING (By G.C.)

- A. Comply with the requirements of Section 099100, Painting.
- B. Where exposed in Finished Areas.
  1. Insulation jacketing.
  2. Hangers, Uninsulated Piping, Miscellaneous Iron Work, Structural Steel Stands, Uninsulated Tanks, Equipment Bases: Paint one coat of black enamel.
  3. Steel Valve Bodies and Bonnets: Paint one coat of black enamel.
  4. Brass Valve Bodies: Not painted.
  5. Equipment Without Factory Finish: Paint one coat of grey machinery enamel. Do not paint nameplates.
  6. Grilles, Diffusers, Registers: Paint sheet metal and visible ductwork behind grilles, diffusers and registers flat black.
  7. Galvanized Ductwork.
- C. Concealed Spaces (above ceilings, not visible):
  1. Insulation: Not painted.
  2. Hangers, Uninsulated Piping, Miscellaneous Iron Work, Valve Bodies and Bonnets: Not painted.
  3. Inside of plenums where visible through grilles/diffusers: flat black.
- D. Exterior Black Steel: Wire brush and apply two coats of rust-inhibiting primer and one coat of grey exterior machinery enamel.

3.13 ADJUSTING AND CLEANING

- A. Before operating equipment or systems, make thorough check to determine that systems have been flushed and cleaned as required and equipment has been properly installed, lubricated, and serviced. Check factory instructions to see that installations have been made properly and that recommended lubricants have been used.
- B. Use particular care in lubricating bearings to avoid blowing out seals from over-lubrication. Check equipment for damage that may have occurred during shipment, after delivery, or during installation. Repair damaged equipment as approved or replace with new equipment.

SECTION 23 05 00 –  
COMMON WORK RESULTS FOR HVAC

3.14 COMMISSIONING

- A. Complete all phases of work so the system, equipment, and components can be checked out, started, calibrated, operationally tested, adjusted, balanced, functionally tested, and otherwise commissioned. Complete systems, including all subsystems, so they are fully functional.
- B. Perform General Commissioning of all systems to ensure correct working operation.
  - 1. Unless specified otherwise in the technical sections, provide factory startup services for the following items of equipment:
    - a. Air handling equipment.
    - b. Heating equipment.
    - c. Cooling equipment.
    - d. Special purpose equipment.
    - e. Exhaust equipment.
    - f. Control dampers.
- C. Participation in Commissioning:
  - 1. Provide skilled technicians to checkout, startup, calibrate, and test systems, equipment, and components.
- D. Resolution of Deficiencies:
  - 1. Corrective work shall be completed to permit timely completion of the commissioning process. Experimentation to render system performance will be permitted.

END OF SECTION 23 05 00

## SECTION 23 21 16

### HYDRONIC PIPING SPECIALTIES

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Air eliminators
- B. Dirt separators
- C. Combination air and dirt separators
- D. Hydraulic separators with integrated air eliminator and dirt separator
- E. Automatic air vents

##### 1.02 REFERENCES

- A. ASME Section VIII, Division 1 - Boiler and Pressure Vessel Code - Pressure Vessels.

##### 1.03 SUBMITTALS

- A. Product Data: Submit for manufactured products and assemblies used in this Project.
  - 1. Manufacturer's data and list indicating use, operating range, total range, accuracy, and location for manufactured components.
  - 2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
  - 3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.

##### 1.04 QUALITY ASSURANCE

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

##### 1.05 WARRANTY

- A. Manufacturer standard warranty indicating that units shall be free from material and workmanship defects from the date of substantial completion for the time periods indicated below:
  - 1. Fabricated steel units: 3 Years.
  - 2. Cast brass units: 20 Years.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect components from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

## PART 2 PRODUCTS

### 2.01 AIR ELIMINATORS

- A. Manufacturers
  - 1. Spirotherm, Inc. (model VSR or VHR)
- B. Full flow coalescing type air eliminator shall be fabricated steel, rated for 150 psig working pressure, and stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels.
- C. Selection shall be based upon system flow with pipe size as a minimum. In no case shall entering velocity exceed 10 feet per second.
- D. Unit shall include internal structured elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% free air, 100% entrained air, and 99.6% dissolved air at the installed location. The elements must be fabricated by the manufacturer and consist of a copper core tube with continuous wound copper wire medium permanently attached and followed by a separate continuous wound copper wire permanently affixed.
- E. Each unit shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism.
- F. Units shall include a side tap valve to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.

### 2.02 DIRT SEPARATORS

- A. Manufacturers
  - 1. Spirotherm, Inc. (model TDT, THT, TDN or THN)
- B. Full flow coalescing type dirt separator shall be fabricated steel, rated for 150 psig working pressure, and stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels.
- C. Selection shall be based upon system flow with pipe size as a minimum. In no case shall entering velocity exceed 10 feet per second.

- D. Unit shall include internal structured elements filling the entire vessel to suppress turbulence and provide minimum dirt separation efficiency of 80% of all particles 30 micron and larger within 100 passes. The elements must be fabricated by the manufacturer and consist of a copper core tube with continuous wound copper wire medium permanently attached and followed by a separate continuous wound copper wire permanently affixed.
- E. A system strainer shall be installed upstream ahead of the dirt separator to catch all large material that may have been left in piping during construction.
- F. Optional: Unit shall be manufactured with a removable lower head for internal inspection if so noted on the drawings and schedule.

## 2.03 COMBINATION AIR ELIMINATOR AND DIRT SEPARATORS

- A. Manufacturers
  - 1. Spirotherm, Inc. (model VDT, VHT, VDN or VHN)
- B. Full flow coalescing type combination air eliminator and dirt separator shall be fabricated steel, rated for 150 psig working pressure, stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels, and include two equal chambers above and below the inlet / outlet nozzles.
- C. Selection shall be based upon system flow with pipe size as a minimum. In no case shall entering velocity exceed 10 feet per second.
- D. Unit shall include internal structured elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% free air, 100% entrained air, and 99.6% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes. The elements must be fabricated by the manufacturer and consist of a copper core tube with continuous wound copper wire medium permanently attached and followed by a separate continuous wound copper wire permanently affixed.
- E. Each unit shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism.
- F. Units shall include a side tap valve to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.
- G. Optional: Unit shall be manufactured with a removable lower head for internal inspection if so noted on the drawings and schedule.

H. Optional: Unit shall be manufactured with internal magnet(s), if so noted on the drawings and schedule.

1. Magnet(s) shall be positioned at the centerline of the inlet and outlet nozzles for maximum effectiveness during normal operation.
  - a. Units sized 2" through 6" shall have one magnet
  - b. Units with 8" though 12" shall have two magnets
2. Magnet(s) shall be removable from the vessel.
3. Magnet(s) shall be made of high-strength Neodymium alloy.
4. Magnet(s) shall be disengaged for dirt blowdown by means of a spring-loaded pull, without requiring removal of the magnet from the vessel or isolating the unit from the system.
5. Magnet option shall be provided with 360° rotatable blow down valve.

#### 2.04 HYDRAULIC SEPARATOR WITH INTEGRATED AIR ELIMINATOR AND DIRT SEPARATOR

A. Manufacturers

1. Spirotherm, Inc. (model VDX, VXN)

B. Full flow coalescing type hydraulic separator shall be fabricated steel, rated for 150 psig working pressure, stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels, and include three performance chambers within the vessel. One chamber above the higher nozzle set for air elimination, one below the lower nozzle set for dirt separation, and one between the nozzles for hydraulic separation.

C. Selection shall be based upon system flows with pipe size as a minimum.

D. Unit shall include internal structured elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% free air, 100% entrained air, and 99.6% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes. The elements must be fabricated by the manufacturer and consist of a copper core tube with continuous wound copper wire medium permanently attached and followed by a separate continuous wound copper wire permanently affixed.

E. Each unit shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism.

- F. Optional: Unit shall be manufactured with a removable lower head for internal inspection if so noted on the drawings and schedule.
- G. Optional: Unit shall be manufactured with internal magnet(s), if so noted on the drawings and schedule.
  - 1. Magnet(s) shall be positioned at the centerline of the bottom inlet and bottom outlet nozzles for maximum effectiveness during normal operation.
    - a. Units sized 2” through 6” shall have one magnet
    - b. Units with 8” though 12” shall have two magnets
  - 2. Magnet(s) shall be removable from the vessel.
  - 3. Magnet(s) shall be made of high-strength Neodymium alloy.
  - 4. Magnet(s) shall be disengaged for dirt blowdown by means of a spring-loaded pull, without requiring removal of the magnet from the vessel or isolating the unit from the system.
  - 5. Magnet option shall be provided with 360° rotatable blow down valve.

## 2.05 AUTOMATIC AIR VENTS

- A. Manufacturers
  - 1. Spirotherm, Inc. (model VTP)
- B. All valves shall be cast brass, rated for 150 psig design pressure and 270°F operating temperature.
- C. Units to include non-ferrous floats, stainless steel linkage and a Viton seal which closes against a brass spring operated seat.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Air eliminator should be installed at the point of lowest solubility in the system: that being where the temperature is the highest (i.e. after the boiler and/or heat exchanger or before the chiller) and the pressure is the lowest (i.e. before the pump suction),
- C. Dirt separators should be installed upstream of the system components that are affected by the dirt in the system. It does not take the place of a system strainer and should be installed after that a strainer to ensure no large construction type debris enters the dirt separator.

- D. Air eliminator, dirt separators and hydraulic separators must be mounted in a straight run of horizontal piping in a perfectly upright position to allow the vent to operate freely and/or dirt to settle. There is no minimum length of straight run required before or after the unit.
- E. The flow may be directed to either side of the unit. There is NO directional arrow. Either connection may be used for inlet or outlet.
- F. Automatic air vents should be installed at high points in the system and / or on specific components requiring a separate vent.

### 3.02 MAINTENANCE

- A. Periodic blow-down through the bottom connection to purge any dirt or sediment collected in the bottom of the vessel is system dependent and may or not be necessary subject to other installed components and overall piping or system condition. A container should be used to catch any debris.
- B. Units with optional removable head can be disassembled and the elements removed for inspection or cleaning. The removable head is a user-specified feature and frequency of inspection and/or cleaning is user or system dependent.

END OF SECTION

SECTION 23 31 00 –  
METAL DUCTS

SECTION 23 31 00 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes rectangular and round metal ducts and plenums for heating, ventilating, air-conditioning systems and kitchen exhaust from type 1 hoods in pressure classes from minus 2- to plus 4- inch wg.
- B. Related Sections include the following:
  - 1. Division 23 Section "Diffusers, Registers, and Grilles."

1.3 DEFINITIONS

- A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C 168. In this Section, these values are the result of the formula  $Btu \times in./h \times sq. \ ft. \times \ deg \ F$  or  $W/m \times K$  at the temperature differences specified. Values are expressed as Btu or W.
  - 1. Example: Apparent Thermal Conductivity (k-Value): 0.26 or 0.037.

1.4 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select and size air-moving and -distribution equipment and other components of air system. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.5 SUBMITTALS

- A. Shop Drawings: Show details of the following:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  2. Duct layout indicating pressure classifications and sizes on plans.
  3. Fittings.
  4. Seam and joint construction.
  5. Penetrations through fire-rated and other partitions.
- B. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
1. Ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
  2. Coordination with ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.
- C. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

#### 1.6 QUALITY ASSURANCE

- A. Welding Standards: Qualify welding procedures and welding personnel to perform welding processes for this Project according to AWS D1.1, "Structural Welding Code-- Steel," for hangers and supports; AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members; and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," unless otherwise indicated.
- C. Comply with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems," unless otherwise indicated.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.
- C. Deliver and store stainless-steel sheets with mill-applied adhesive protective paper maintained through fabrication and installation.

## PART 2 - PRODUCTS

## 2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8- inch minimum diameter for lengths longer than 36 inches.

## 2.2 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
  - 1. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 percent solids.
  - 2. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

## 2.2 LISTED DUCTWORK FOR REMOVAL OF GREASE AND SMOKE LADEN VAPORS

- A. The grease duct shall be insulated double-wall factory built type for use with Type I kitchen hoods, as described in NFPA-96 for the transportation of air and grease-laden vapors from commercial cooking operation.
- B. Product Description:
  - 1. Metal-Fab Series 2G Grease Duct.
  - 2. Factory prefabricated, double wall type, listed for venting of grease laden air from Type I kitchen hoods requiring grease duct as described in NFPA 96.
  - 3. Rated for continuous operation at 500° F and intermittent operation at 2000° F.
  - 4. All components of the grease duct system shall be provided by the manufacturer to ensure the system meets the requirements of the listing including duct supports, guides, fittings, cleanouts, and expansion joints required to install the duct.
  - 5. Grease duct shall be listed by UL with the associated listed reports:
    - i. UL 1978 (File MH8251) - Grease Ducts for Restaurant Cooking Appliances.
    - ii. UL103HT (MH8251) - Standard for factory built chimneys and building heating appliances.
    - iii. UL2221 (File R 15388) – Condition B – evaluated as an alternative to a 2 hour site-built and chased installation, with 3 inches minimum clearance to a fully enclosed combustible construction.
  - 6. The duct sections shall be constructed of an inner wall and an outer wall with 2” of ceramic fiber insulation between the walls.
    - i. The inner wall shall be constructed of 304, 316 or 430 stainless steel.
      - 1. 6 through 36 inch diameter materials: 0.035 inch thick inner wall.
      - 2. 38 through 48 inch diameter materials: 0.048 inch thick inner wall.
    - ii. The outer wall shall be constructed of aluminized steel, 304 or 316 stainless steel.

1. 6 thru 22 diameter inch materials: 0.024 inch thick outer wall.
2. 24 thru 48 inch diameter materials: 0.034 thick outer wall.
- iii. The duct shall include a 2" thickness of body soluble ceramic fiber insulation between the inner and outer walls.
7. The duct wall assembly is Tested and Listed to 1 inch clearance to combustibles for 6 inch to 18 inch diameters, 2 inches clearance to combustibles for 20 to 32 inch diameters, 3 inches clearance to combustibles for 34 to 42 inch diameters, 4 inches clearance to combustibles for 44 to 48 inch diameters.

### 2.3 HANGERS AND SUPPORTS

- A. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.
  1. Straps and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.
- B. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- C. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
  1. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.

### 2.4 RECTANGULAR DUCT FABRICATION

- A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
  1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
  2. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

- B. Fabricate range hood exhaust ducts with 20 ga., 316 stainless-steel sheet. Weld and flange seams and joints. Comply with NFPA 96.
- C. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:
  - 1. Supply Ducts: 2-inch wg.
  - 2. Return Ducts: 2-inch wg, negative pressure.
  - 3. Exhaust Ducts: 2-inch wg, negative pressure.
- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of unbraced panel area, unless ducts are lined.

## 2.5 ROUND DUCT FABRICATION

- A. General: Diameter as applied to flat-oval ducts in this Article is the diameter of the size of round duct that has a circumference equal to perimeter of a given size of flat-oval duct.
- B. Round Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

## 2.6 ROUND SUPPLY AND EXHAUST FITTING FABRICATION

- A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal seam straight duct.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.
- C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate bend radius of die-formed, gored, and pleated elbows one and one-half times elbow diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
  - 1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION, GENERAL

- A. Drawings indicate general arrangement of ducts, fittings, and accessories.

- B. Construct and install each duct system for the specific duct pressure classification indicated.
- C. Install round ducts in lengths not less than 12 feet, unless interrupted by fittings. D. Install ducts with fewest possible joints.
- E. Install fabricated fittings for changes in directions, changes in size and shape, and connections.
- F. Install couplings tight to duct wall surface with a minimum of projections into duct.
- G. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- K. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- L. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches.

### 3.2 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Pressure Classification Less Than 2-Inch wg: Transverse joints. C. Seal externally insulated ducts before insulation installation.

### 3.3 CONSTRUCTION OF FACTORY BUILT GREASE DUCT

- A. Inner pipe joints shall be held together by means of formed vee bands and sealed with P080 Grease Duct Sealant.
- B. Connection to the hood will be made with a round hood collar or a square-to-round transition.
- C. Curb mounted fans will incorporate a fan adapter plate.

- D. All construction and supporting of the kitchen ventilation system will be in accordance with Metal-Fab, Inc. installation instructions.
- E. Store grease duct sections inside or covered adequately to protect from weather or accidental damage

#### 3.4 HANGING AND SUPPORTING

- A. Install rigid round, rectangular, and flat-oval metal duct with support systems indicated in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

#### 3.4 CONNECTIONS

- A. Connect equipment with flexible connectors.
- B. For branch, outlet and inlet, and terminal unit connections, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

#### 3.5 FIELD QUALITY CONTROL

- A. Disassemble, reassemble, and seal segments of systems as required to accommodate leakage testing and as required for compliance with test requirements.
- B. Conduct tests, in presence of Owner's representative, at static pressures equal to maximum design pressure of system or section being tested. If pressure classifications are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
- C. Determine leakage from entire system or section of system by relating leakage to surface area of test section.
- D. Maximum Allowable Leakage: Comply with requirements for Leakage Classification 3 for round and flat-oval ducts, Leakage Classification 12 for rectangular ducts in pressure classifications less than and equal to 2-inch wg (both positive and negative pressures), and Leakage Classification 6 for pressure classifications from 2- to 10-inch wg.
- E. Remake leaking joints and retest until leakage is less than maximum allowable.
- F. Leakage Test: Perform tests according to SMACNA's "HVAC Air Duct Leakage Test"

Manual."

3.6 ADJUSTING

- A. Adjust volume-control dampers in ducts, outlets, and inlets to achieve design airflow.
- B. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for detailed procedures.

3.7 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect the system. Vacuum ducts before final acceptance to remove dust and debris.

END OF SECTION 23 31 00

SECTION 23 37 00 –  
DIFFUSERS, REGISTERS, AND GRILLES

SECTION 23 37 00 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles. B.

Related Sections include the following:

- 1. Division 23 Section "Testing, Adjusting, and Balancing" for balancing diffusers, registers, and grilles.

1.3 DEFINITIONS

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper assembly over an air opening.

1.4 SUBMITTALS

- A. Product Data: For each model indicated, include the following:
  - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
  - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
  - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

SECTION 23 37 00 –  
DIFFUSERS, REGISTERS, AND GRILLES

- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for diffusers, registers, and grilles with factory-applied color finishes.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Diffusers, registers, and grilles are scheduled on Drawings.

2.2 SOURCE QUALITY CONTROL

- A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in

SECTION 23 37 00 –  
DIFFUSERS, REGISTERS, AND GRILLES

ceiling panels, locate units in the center of the panel.

Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

- C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 23 37 00

SECTION 26 05 19 -  
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

SECTION 26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:

1. Division 27 Sections for cabling used for voice and data circuits.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by UL and marked for intended use.

B. Comply with ASTM.

C. Comply with UL 44, 83, and 486.

D. Comply with NFPA 70.

E. Comply with FM Global requirements.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Include data sheets for the following additional items:

1. Splices and terminations.
2. Pulling compounds.
3. Cable accessories.

C. Field quality-control test reports.

PART 2 - PRODUCTS

SECTION 26 05 19 -  
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. General Cable Corporation.
  2. Okonite.
  3. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

1. Aluminum conductors shall not be used under any circumstances.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW-2 and SO.

1. Voltage rating: 600 Volts for 480/277V and 208/120V.

D. Multi-conductor Cable type MC and AC: Use of MC or medical grade AC cable is not permitted under any circumstances unless specifically approved in writing by the Owner.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Burndy, Thomas & Betts.
  2. O-Z/Gedney; EGS Electrical Group LLC.
  3. 3M; Electrical Products Division.
  4. IlSCO.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

1. Aboveground Circuits (No. 10 AWG and smaller):
  - a. Connectors: Solderless, screw-on, reusable pressure cable type, rated 600 V, 90° C, with integral insulation, approved for copper conductors.
  - b. The integral insulator shall have a skirt to completely cover the stripped wires.
  - c. The number, size, and combination of conductors, as listed on the manufacturer's packaging, shall be strictly followed.
2. Aboveground Circuits (No. 8 AWG and larger):
  - a. Cable termination lugs shall be made of high conductivity and corrosion-resistant material, electro-tin plated, listed for use with copper conductors only, rated for 600 V. Lugs shall be color coded by size.
  - b. Cable termination lugs shall be indent type, long barrel with chamfered entry, 2 – hole, compression type for 250 kcmil and above, 1 – hole for less than 250 kcmil.

SECTION 26 05 19 -  
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Soft annealed Copper stranded, class B compressed.
- B. Branch Circuits: Copper. Solid for No. 16 AWG and smaller; stranded for No. 14 AWG and larger.
- C. Minimum Wire Size: #12 awg for power and lighting circuits, #14 awg for control circuits. In the case of "homeruns" over 125 feet in length, no conductor smaller than a No. 10 wire shall be used. The tap conductor from the J-box in the ceiling to the receptacle may be No. 12. Each 120-volt phase conductor shall have a neutral conductor of the same size. The sizing of all wire except remote control wire shall be accomplished in the case of both feeder and branch circuits by conforming to the following provisions. Only lighting circuits may share grounding conductors. All lighting circuits with shared grounding conductors shall be #10 AWG minimum.

3.2 CONDUCTOR INSULATION AND MULTI-CONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW, or type THHN/THWN up to and including 600 kcmil.
- B. Exposed Feeders: Type XHHW for #2 awg and larger, or type THHN/THWN for all sizes up to and including 600 kcmil, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type XHHW for #2 awg and larger, or type THHN/THWN for all sizes up to and including 600 kcmil, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and underground: Type XHHW for #2 awg and larger, or type THHN/THWN for all sizes up to and including 600 kcmil, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and underground: Type THHN-THWN, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, and strain relief device at terminations to suit application.

SECTION 26 05 19 -  
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

- I. Recessed or Semi-recessed Lighting Fixture Whips: Type THHN-THWN (90 deg C), single conductors in FMC in lengths not to exceed six (6) feet.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Splices in feeder circuits shall be avoided unless necessitated by the length of the run. Locations of all splices shall be approved by the Office of Facilities.
- B. Conductors may be run parallel from sizes 250 kcmil up to and including 600 kcmil provided all paralleled conductors are of the same size, manufacturer, length and type of insulation.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems" for secondary service, feeders and branch circuits.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly as per drawings.
  1. All penetrations shall be under constant visual surveillance until firestopping is applied unless an approved "ILSM" is in place for each location.
  2. Products: Specified Technologies, Inc.

SECTION 26 05 19 -  
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements. a. Generator, UPS, Isolated Power Panel, Fire Pump.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace non-compliant cables or wires and retest as specified above.

END OF SECTION 26 05 19

SECTION 26 05 23 –  
CONTROL-VOLTAGE ELECTRICAL POWER CABLES

SECTION 26 05 23 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

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. Low-voltage control cabling.
  2. Control-circuit conductors.
  3. Identification products.

1.3 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment used for remote-control and signaling power-limited circuits.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wire and cable to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

SECTION 26 05 23 –  
CONTROL-VOLTAGE ELECTRICAL POWER CABLES

2. Smoke-Developed Index: 50 or less.

B. 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.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 LOW-VOLTAGE CONTROL CABLE

A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Plastic jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.3 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 83.

B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 83.

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or Type TF, complying with UL 83.

2.4 IDENTIFICATION PRODUCTS

SECTION 26 05 23 –  
CONTROL-VOLTAGE ELECTRICAL POWER CABLES

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

- A. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

3.2 INSTALLATION OF CONDUCTORS AND CABLES A.

Comply with NECA 1.

- B. General Requirements for Cabling:

1. Terminate all conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, and panels.
2. Cables may not be spliced. Secure and support open cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, and terminals.
3. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
4. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.

- C. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

3.3 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables.

3.4 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits, No. 12 AWG.

3.5 FIRESTOPPING

SECTION 26 05 23 –  
CONTROL-VOLTAGE ELECTRICAL POWER CABLES

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Sections.

1. All penetrations shall be under constant visual surveillance until firestopping is applied unless an approved "ILSM" is in place for each location.
2. Products: Specified Technologies, Inc.

3.6 GROUNDING

A. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  2. Perform continuity tests and checks.
- B. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 26 05 23

SECTION 260526 –  
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Grounding systems and equipment.
- B. Section includes grounding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding.
  - 2. Ground bonding common with lightning protection system.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
  - 1. Test wells.
  - 2. Ground rods.
  - 3. Ground rings.
  - 4. Grounding arrangements and connections for separately derived systems.
  - 5. Grounding for sensitive electronic equipment.
  - 6. Field quality control reports

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, and grounding connections for separately derived systems based on NFPA 70B.

SECTION 260526 –  
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

- a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
- b. Include recommended testing intervals.

1.6 QUALITY ASSURANCE

- A. 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.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Comply with NFPA 70.
- D. Comply with FM Global requirements.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Tinned-copper wire or cable insulated for 600 V with green colored insulation, UL 44 or UL 83 listed, unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, provided with standard NEMA bolt hole sizing and spacing for the type of connectors to be used. Stand-off insulators for mounting shall comply with UL 891

SECTION 260526 –  
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

for use in switchboards, 600 V, Lexan or PVC, impulse tested at 5000 V. Provide clear Lexan cover over connections.

2.2 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solder-less compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
  - 1. Bury at least 24 inches (600 mm) below grade.
  - 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank as part of duct-bank installation. Bury detectable warning tape approximately 6 inches (150 mm) above grounding conductors. Warning tape shall comply with Section 260553.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

SECTION 260526 –  
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

- D. Grounding Bus: Install in electrical rooms, in rooms housing service equipment, and elsewhere as indicated.
1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (300 mm) above finished floor unless otherwise indicated.
  2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.
- E. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  2. Underground Connections: Exothermic welded connectors except at test wells and as otherwise indicated.
  3. Connections to Ground Rods at Test Wells: Bolted connectors.
  4. Connections to Structural Steel: Exothermic welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, non-shrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned copper conductor not less than No. 2/0 for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 12 inches (300 mm) from the foundation.

3.3 UTILITY GROUNDING

SECTION 260526 –  
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

- A. Provide grounding and bonding at Utility Company’s metering equipment in accordance with Utility Company’s requirements.

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.

- 1. Conduit shall not be used as the ground conductor.
- 2. In Healthcare facilities, metallic conduit may be used as the additional means of grounding where the raceway system qualifies as a grounding conductor in accordance with NEC 250.118.

- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

- 1. Feeders and branch circuits.
- 2. Lighting circuits.
- 3. Receptacle circuits.
- 4. Single-phase motor and appliance branch circuits.
- 5. Three-phase motor and appliance branch circuits.
- 6. Flexible raceway runs.
- 7. Armored cable runs.
- 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
- 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

- D. Water Heater, Heat-Tracing, and Anti-frost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a

SECTION 260526 –  
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

- G. Panelboard Bonding in Patient Care Areas: The equipment grounding terminal buses of the normal and essential branch circuit panel boards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than No. 10 AWG installed in rigid metal conduit.
- H. Cable trays shall be grounded and bonded in accordance with N.E.C. requirements.
- I. Raised floors: Provide bonding of all raised floor components.
- J. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- K. Outdoor metallic fences around electrical equipment shall be grounded.

3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
  - 1. Where ground conductors are subject to physical damage, install in raceway.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 12 inches (100 mm) below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
- D. Test Wells: Ground rod driven through bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.

SECTION 260526 –  
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
1. Install tinned-copper conductor not less than No. 4/0 AWG for ground ring and for taps to building steel.
  2. Bury ground ring not less than 24 inches (600 mm) from building's foundation.
- J. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.

SECTION 260526 –  
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.6 LABELING

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

- a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
- b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:

SECTION 260526 –  
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1. Power and Lighting Equipment or System with Capacity of 500 kVA and less: 10 ohms.
  2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
  3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
  4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
  5. Substations and Pad-Mounted Equipment: 5 ohms.
  6. Manhole Grounds: 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 –  
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Sections include the following:

1. Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

SECTION 26 05 29 –  
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

- A. Product Data: For the following:
  - 1. Steel slotted support systems.
  - 2. Nonmetallic slotted support systems.
  
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze hangers. Include Product Data for components.
  - 2. Steel slotted channel systems. Include Product Data for components.
  - 3. Nonmetallic slotted channel systems. Include Product Data for components.
  - 4. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. All products shall be UL labeled for their intended use.
- C. Comply with NFPA 70.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Sections.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.

SECTION 26 05 29 –  
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

- c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
  - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-
- 4.
  - 5. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
  - 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
  - 3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
  - 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

SECTION 26 05 29 –  
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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

- 1) Hilti Inc.
- 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
- 3) MKT Fastening, LLC.
- 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

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

- 1) Cooper B-Line, Inc.; a division of Cooper Industries.
- 2) Empire Tool and Manufacturing Co., Inc.
- 3) Hilti Inc.
- 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc. 5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

## 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Sections for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

SECTION 26 05 29 –  
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps or singlebolt conduit clamps using spring friction action for retention in support channel.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1 1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

E. Fire pump feeders that are run exposed shall have conduit supported every five feet from a two hour rated structure with UL listed components.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.

SECTION 26 05 29 –  
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Sections for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment. C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit and four inches high, and so anchors will be a minimum of 10 bolt diameters from edge of the base. Edges shall be chamfered.

B. Use 3000-psi (20.7-MPa) 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Concrete Sections.

C. Install dowel rods to connect concrete bases to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base. D. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

SECTION 26 05 29 –  
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

- B. Touchup: Comply with requirements in Division 09 Painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A-780.

END OF SECTION 26 05 29

SECTION 26 05 33 –  
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
  2. Nonmetal conduits, tubing, and fittings.
  3. Metal wireways and auxiliary gutters.
  4. Nonmetal wireways and auxiliary gutters.
  5. Surface raceways.
  6. Poke Thru Assemblies.
  7. Trench Duct.
  8. Boxes, floor boxes, enclosures, and cabinets.
- B. Related Requirements:

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 QUALITY ASSURANCE

- A. All products shall be UL labeled for their intended use.
- B. Comply with NFPA 70.

SECTION 26 05 33 –  
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, products of all manufacturers are acceptable provided they have a smooth interior, are UL listed and labeled as defined in NFPA 70 for the intended location and application and are electro-galvanized steel (EMT) or hot dipped galvanized steel inside and out (GRC). Conduit and fittings shall be obtained from the same manufacturer:

B. GRC: Comply with ANSI C80.1 and UL 6.

C. ARC: Comply with ANSI C80.5 and UL 6A.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. EMT: Comply with ANSI C80.3 and UL 797.

F. FMC: Comply with UL 1; zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

H. Multi-conductor Cable type MC and AC: Use of MC or medical grade AC cable is not permitted under any circumstances unless specifically approved in writing by the Owner.

I. Electrical nonmetallic tubing (ENT or “blue tube”) and liquid-tight flexible nonmetallic conduit (LFNC) are not acceptable for use on any Project.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.

2. Fittings for EMT:

a. Material: Steel.

b. Type: Set Screw – indoors; compression - outdoors.

SECTION 26 05 33 –  
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

K. Joint Compound for IMC, ARC, or GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, products of all manufacturers are acceptable provided they are sunlight resistant and UL listed and labeled as defined in NFPA 70 and marked for intended location and application. Conduit and fittings shall be obtained from the same manufacturer.

B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

C. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

D. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

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

1. Cooper B-Line, Inc.
2. Hoffman; a Pentair company.
3. Square D; a brand of Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

SECTION 26 05 33 –  
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Hoffman; a Pentair company.
  - 2. Lamson & Sessions; Carlon Electrical Products.
- B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be UL listed and labeled as defined in NFPA 70 and marked for intended location and application.
- C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- E. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways shall be UL listed and labeled as defined in NFPA 70 and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect. Provide dividers as required to separate systems of different voltages.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Panduit Corp.
    - b. Wiremold / Legrand.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for

SECTION 26 05 33 –  
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

self-extinguishing characteristics. Provide dividers as required to separate systems of different voltages.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Hubbell Incorporated; Wiring Device-Kellems Division.
  - b. Panduit Corp.
  - c. Wiremold / Legrand.

2.6 POKE THRU ASSEMBLIES

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

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Pass & Seymour/Legrand; Wiring Devices & Accessories.
3. Thomas & Betts Corporation.
4. Wiremold Company (The).

B. Poke-Thru Assemblies:

1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
  2. Poke-thru box fittings shall maintain a minimum two-hour fire rating.
  3. Comply with UL 514 scrub water exclusion requirements.
  4. Service Outlet Assembly: Flush type with services indicated.
  5. Selected to fit nominal 4-inch (100-mm) cored holes in floor and matched to floor thickness.

2.7 BOXES, ENCLOSURES, AND CABINETS

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

1. Cooper Crouse-Hinds.
2. EGS/Appleton Electric.
3. Hubbell Incorporated; Killark Division.
4. O-Z/Gedney; a brand of EGS Electrical Group.
5. RACO; a Hubbell Company.
6. Thomas & Betts Corporation.
7. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

SECTION 26 05 33 –  
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes:
  - 1. Material: Sheet metal, 11 gauge.
  - 2. Type: Flush. Cover with 0.25”square aluminum flange rated for carpet/tile installations. Provide pour pan accessory for on grade installations.
  - 3. Shape: Rectangular.
  - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled UL 514A.
  - 5. Manufacturers: FSR FL-500P.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: GRC, IMC, or RNC, Type EPC-80-PVC.
  - 2. Concealed Conduit, Aboveground: IMC, EMT, or RNC, Type EPC-40-PVC.
  - 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried or concrete encased as indicated.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
  - 3. Exposed and Subject to Severe Physical Damage: GRC.
  - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  - 6. Feeders over 600 V: GRC.
  - 7. Damp or Wet Locations: GRC or IMC.
  - 8. Tunnels: GRC.
  - 9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations. C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

SECTION 26 05 33 –  
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- D. Mixing different types of conduits indiscriminately in the same system is prohibited.
- E. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. EMT: Use setscrew (indoors) or compression (outdoors), steel fittings. Comply with NEMA FB 2.10.
  - 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hotwater pipes. Install horizontal raceway runs above water and steam piping.
- C. Installation of all new conduits must be minimum 12 inches from ceiling grid except where approved by Architect.
- D. Complete raceway installation before starting conductor installation.
- E. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.
- F. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- G. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- H. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- I. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- J. Raceways Embedded in Slabs:

SECTION 26 05 33 –  
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location. Fittings shall be concrete tight. K. Stub-ups to Above Recessed Ceilings:
  1. Use EMT for raceways.
  2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- L. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- S. Surface Raceways:
  1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.

SECTION 26 05 33 –  
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
3. Non-metallic surface raceways shall not be installed in patient care areas.
- T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where an underground service raceway enters a building or structure.
  3. Where otherwise required by NFPA 70.
- V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- W. Expansion-Joint Fittings:
  1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
  2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
    - d. Attics: 135 deg F (75 deg C) temperature change.
  3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

SECTION 26 05 33 –  
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC in damp or wet locations not subject to severe physical damage.
  3. Use a maximum of 72 inches (1830 mm) of FMC for recessed and semi-recessed luminaires.
  4. Final connections to motors or equipment subject to vibration, noise transmission, or movement shall use FMC not exceeding four feet in length.
  5. Short lengths of FMC shall be used for final primary and secondary connections to Low Voltage transformers (<600V).
- Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- AA. Do not install boxes back-to-back in walls. Provide minimum 6-inch separation in non-firerated walls. Provide minimum 24-inch horizontal separation in acoustic-rated walls.
- BB. Boxes shall be secured between two studs. Boxes connected to one stud are not permitted.
- CC. Locate boxes so that cover or plate will not span different building finishes.
- DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- FF. Set metal floor boxes level and flush with finished floor surface.
- GG. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

SECTION 26 05 33 –  
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Sections.

1. All penetrations shall be under constant visual surveillance until firestopping is applied unless an approved "ILSM" is in place for each location.
2. Products: Specified Technologies, Inc.

3.5 IDENTIFICATION

A. Junction boxes of different systems shall be identified by colors indicated below. Box and cover shall be painted prior to attaching identification labels.

B. Provide permanent nameplates for all pull and junction boxes identifying circuits, voltage, and source.

C. Raceways and couplers of different systems shall be identified by color. Raceways up to 2" shall have factory applied finish.

1. Raceways larger than 2" shall be identified by permanent snap-on color bands installed within six inches of any pull or junction box, enclosure, fitting, and every thirty feet of run.

D. Colors:	System:
1. Red:	Fire Alarm.
2. Yellow:	Critical Branch.
3. Purple:	Life Safety.
4. Orange:	Equipment Emergency Branch.
5. Green:	Normal power.
6. Blue:	Communications.
7. Black:	Low Voltage.

3.6 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to coatings or paint finishes with matching touchup coating recommended by manufacturer.

SECTION 26 05 33 –  
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

**END OF SECTION 26 05 33**

SECTION 26 05 43 –  
UNDERGROUND DUCTS & RACEWAYS FOR ELECTRICAL SYSTEMS

SECTION 26 05 43 - UNDERGROUND DUCTS & RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
  - 2. Handholes and boxes.
  - 3. Manholes.

1.3 DEFINITION

- A. RNC: Rigid nonmetallic conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Duct-bank materials, including separators and miscellaneous components.
  - 2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
  - 3. Accessories for manholes, handholes, boxes, and other utility structures.
  - 4. Warning tape.
- A. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Shop drawings shall be sealed by a Professional Engineer. Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
  - 1. Duct entry provisions, including locations and duct sizes.
  - 2. Reinforcement details.
  - 3. Frame and cover design and manhole frame support rings.
  - 4. Ladder details.
  - 5. Grounding details.
  - 6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
  - 7. Joint details.

- B. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
  - 1. Duct entry provisions, including locations and duct sizes.
  - 2. Cover design.
  - 3. Grounding details.
  - 4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
  - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
- B. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.
- C. Qualification Data: For professional engineer.
- D. Source quality-control test reports.
- E. Field quality-control test reports.

#### 1.6 QUALITY ASSURANCE

- A. All products shall be UL labeled for their intended use.
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Lift and support precast concrete units only at designated lifting or supporting points.

## 1.8 COORDINATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by the Architect.

## PART 2 - PRODUCTS

### 2.1 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

### 2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, products of all manufacturers are acceptable provided they are sunlight resistant and UL listed for the intended installation. Conduit and fittings shall be provided from the same manufacturer whenever possible.
- B. Duct Accessories:
  - 1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
  - 2. Warning Tape: Underground-line warning tape specified in Division 26 Section 260553 "Identification for Electrical Systems."

### 2.3 HANDHOLES AND BOXES

- A. Description: Comply with SCTE 77.
  - 1. Color: Gray.
  - 2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
  - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
  - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  - 5. Cover Legend: Molded lettering, as indicated for each service.
  - 6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for

- secure, fixed installation in enclosure wall.
- 7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- 8. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armorcast Products Company.
  - b. Highline Products
  - c. Quazite, Hubbell Power Systems.

## 2.4 PRECAST MANHOLES

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

- 1. Lindsey Concrete Products.
- 2. Mack Industries.
- 3. Norwalk Concrete Industries.
- 4. Oldcastle Precast, Inc.

B. Comply with ASTM C 858, with structural design loading as specified in Part 3 "Underground Enclosure Application" Article and with interlocking mating sections, complete with accessories, hardware, and features.

- 1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
  - a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
  - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
  - c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

C. Concrete Knockout Panels: 1-1/2 to 2 inches (38 to 50 mm) thick, for future conduit entrance and sleeve for ground rod.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

## 2.5 UTILITY STRUCTURE ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bilco Company (The).
  2. East Jordan Iron Works, Inc.
  3. McKinley Iron Works, Inc.
  4. Neenah Foundry Company.
  5. Pennsylvania Inset Corporation.
  6. Underground Devices, Inc.
- B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 29 inches (737 mm).
    - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
    - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
    - c. Covers shall have locking provisions.
  2. Cover Legend: Cast in. Selected to suit system.
    - a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
    - b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
    - c. Legend: "SIGNAL" for communications, data, and telephone duct systems.
  3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
    - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. (60 L) where packaged mix complying with ASTM C 387, Type M, may be used.
- C. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.
- D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- (50- mm-) diameter eye, and 1-by-4-inch (25-by-100-mm) bolt.
1. Working Load Embedded in 6-Inch (150-mm), 4000-psi (27.6-MPa) Concrete: 13,000- lbf (58-kN) minimum tension.
- E. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- (22-mm-) diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf (180-kN) shear and 60,000-lbf (270-kN) tension.
- F. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch (13-mm) ID by 2-3/4 inches (69 mm) deep, flared to 1-1/4 inches (32 mm) minimum at base.
1. Tested Ultimate Pullout Strength: 12,000 lbf (53 kN) minimum.
- G. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.
1. Stanchions: Nominal 36 inches (900 mm) high by 4 inches (100 mm) wide, with minimum of 9 holes for arm attachment.
  2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches (75 mm) with 450-lb (204-kg) minimum capacity to 20 inches (508 mm) with 250-lb (114-kg) minimum capacity. Top of arm shall be nominally 4 inches (100 mm) wide, and arm shall have slots along full length for cable ties.
- H. Duct-Sealing Compound: Non-hardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- I. Fixed Manhole Ladders: Arranged for attachment to roof or wall and floor of manhole. Ladder and mounting brackets and braces shall be fabricated from hot-dip galvanized steel.
- J. Cover Hooks: Heavy duty, designed for lifts 60 lbf (270 N). Two required.

## 2.6 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.
- B. Non-concrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 UNDERGROUND DUCT APPLICATION

- A. Minimum conduit/duct size for underground installations shall be one inch.
- B. Ducts for Electrical Cables over 600 V: RNC, NEMA Type EPC-40 PVC, in concrete-encased duct bank, unless otherwise indicated.
- C. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40 PVC, in concrete-encased duct bank, unless otherwise indicated.
- D. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40 PVC, in direct-buried duct bank, unless otherwise indicated.
- E. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40 PVC, in direct-buried duct bank, unless otherwise indicated.
- F. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40 PVC, in concrete-encased duct bank, unless otherwise indicated.
- G. Underground Ducts Crossing Paved Paths, Walks, Driveways and Roadways: RNC, NEMA Type EPC-40 PVC, encased in reinforced concrete.
- H. A nylon pull cord shall be installed and tied off in each duct, including spares. The nylon pull cord shall have a minimum tensile strength of 200 pounds.

### 3.2 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:
  - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
  - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Non-deliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20; Polymer concrete, SCTE 77, Tier 15 structural load rating.
  - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Non-deliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10, Polymer concrete units, SCTE 77, Tier 8 structural load rating.
- B. Manholes: Precast concrete.
  - 1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
  - 2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

### 3.3 EARTHWORK

- A. Excavation and Backfill: Comply with earth moving sections in Division 31 Specifications, but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary top-soiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with plantings Sections in Division 32 Specifications.
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to appropriate Division 01 Sections.

### 3.4 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and **away from buildings and equipment**. Slope ducts from a high point in runs between two manholes to drain in both directions.
  1. Water intrusion into buildings through ducts is not acceptable.
  2. This Contractor shall be fully responsible for corrective action necessary to insure water infiltration is eliminated.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Manholes and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) O.C. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.
  1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
  2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
  3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet (3 m) outside the building wall **without reducing duct line slope away from the building**, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03- MPa) hydrostatic pressure.

G. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Division 03 Concrete Sections.
3. Concreting Sequence: Place each run of concrete envelope between manholes or other terminations in one continuous operation.
  - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the concrete placement. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
  - b. If more than one concrete placement is necessary, terminate each in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
4. Placing Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application. Red dye shall be added to the top of the concrete during the placement.
5. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth, road crossings and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
6. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be placed without soil inclusions; otherwise, use forms.
7. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 12 inches (300 mm) between power and signal ducts.
8. Depth: Install top of duct bank at 36 inches (900 mm) below finished grade, unless otherwise indicated.
9. Stub-Ups: Use manufactured PVC elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated for circuit conductors smaller than No. 1/0 AWG and under 600 volts. Extend concrete encasement throughout the length of the elbow.
10. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor for all circuit conductors over 600 volts and circuits under 600 volts with conductor size No. 1/0 AWG or larger.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
  - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend

steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.

11. Warning Tape: Comply with Section 260553. Bury detectable warning tape approximately 18 inches (450 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

H. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in earth moving sections in Division 31 Specifications for pipes less than 6 inches (150 mm) in nominal diameter.
4. Install backfill as specified in earth moving sections in Division 31 Specifications.
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in earth moving sections in Division 31 Specifications.
6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 12 inches (300 mm) between power and signal ducts.
7. Depth: Install top of duct bank at 36 inches (900 mm) below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
10. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
  - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
11. Warning Tapes: Comply with Section 260553. Bury detectable warning tape approximately 18 inches (450 mm) above all duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450

mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

### 3.5 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

#### A. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891, unless otherwise indicated.
2. Install unit level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

#### B. Elevations:

1. Manhole Roof: Install with rooftop at least 18 inches (450 mm) below finished grade.
2. Manhole Frame: In paved areas and traffic-ways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.
3. Install handholes with bottom below the frost line, 42" below grade.
4. Handhole Covers: In paved areas and traffic-ways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

#### C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

#### D. Manhole Access: Circular opening in manhole roof; sized to match cover size.

1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

#### E. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Division 07. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days. Joint between manhole and chimney shall be sealed with a flexible epoxy or EPDM rubber seal.

#### F. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms as required for installation and support of cables and conductors and as indicated.

#### G. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

#### H. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (98 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts

installed in the field. Use a minimum of two anchors for each cable stanchion.

- I. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

### 3.6 INSTALLATION OF HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and traffic-ways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
- D. Install handholes and boxes with bottom below the frost line, 42" below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and concrete and subject to occasional, non-deliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
  1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Division 03 Concrete Sections with a troweled finish.
  2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

### 3.7 GROUNDING

- A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

### 3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

### 3.9 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 05 43

SECTION 26 05 44 –  
SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS & CABLING

SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS &  
CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Comply with Division 07 Sections for penetration firestopping installed in fire-resistancerated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 QUALITY ASSURANCE

- A. All products shall be UL labeled for their intended use.
- B. Comply with FM Global requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:

SECTION 26 05 44 –  
SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS & CABLING

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. Sleeves for Rectangular Openings:
  1. Material: Galvanized sheet steel.
  2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
    - b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

## 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Pipeline Seal & Insulator, Inc. (Link Seal).
  2. Sealing Elements: Rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  3. Pressure Plates: Carbon Steel, Composite, Stainless Steel.
  4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, water-stop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber water-stop collar with center opening to match piping OD.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Pipeline Seal & Insulator, Inc. (Link Seal).

## 2.4 GROUT

- A. Description: Non-shrink; recommended for interior and exterior sealing openings in non-fire rated walls or floors.

SECTION 26 05 44 –  
SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS & CABLING

- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
  - 2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Sections for joint sealants
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. De-burr after cutting.

SECTION 26 05 44 –  
SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS & CABLING

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 3 inches (75 mm) above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position water-stop flange to be centered in concrete slab or wall. C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

SECTION 26 05 44 –  
SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS & CABLING

END OF SECTION 26 05 44

SECTION 26 05 53 –  
IDENTIFICATION FOR ELECTRICAL SYSTEMS

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

SECTION 26 05 53 –  
IDENTIFICATION FOR ELECTRICAL SYSTEMS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at more than 600 V:
  - 1. Black letters on an orange field.
  - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-(75-mm-) high letters.
- C. Colors for Raceways Carrying Circuits at 600 V or Less and conduits larger than two inches:
  - 1. Black letters on a white field.
  - 2. Legend: Indicate voltage and system or service type.
- D. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less and conduits larger than two inches: Slit, pre-tensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Colors for Raceways Carrying Circuits at 600 V or Less and conduits two inches and less:
  - 1. Factory applied color finish, comply with Section 260533.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tapes not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

SECTION 26 05 53 –  
IDENTIFICATION FOR ELECTRICAL SYSTEMS

- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- D. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.4 FLOOR MARKING TAPE

- A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.5 UNDERGROUND-LINE WARNING TAPE A.

Tape:

- 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
  - 4. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
  - 5. Overall Thickness: 5 mils (0.125 mm).
  - 6. Foil Core Thickness: 0.35 mils (0.00889 mm).
  - 7. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
  - 8. 3-Inch (75-mm) Tensile According to ASTM D 882: 70 lbf (311.3 N), and 4600 psi (31.7 MPa).
- B. Color and Printing:
- 1. Comply with ANSI Z535.1 through ANSI Z535.5.
  - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
  - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.6 WARNING LABELS AND SIGNS

SECTION 26 05 53 –  
IDENTIFICATION FOR ELECTRICAL SYSTEMS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Baked-Enamel Warning Signs:
  - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
  - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
  - 3. Nominal size, 7 by 10 inches (180 by 250 mm).
- C. Metal-Backed, Butyrate Warning Signs:
  - 1. Weather-resistant, non-fading, preprinted, cellulose-acetate butyrate signs with 0.0396inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
  - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
  - 3. Nominal size, 10 by 14 inches (250 by 360 mm).
- D. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 48 INCHES (1220 MM)."
  - 3. Flash Protection Field Marking: All panelboards, switchgear, switchboards, panelboards motor control centers, motor control panels and electrical control panels shall be provided with a black on yellow warning sign per ANSI Z535.4 and ISO 3864. The sign shall read:  
"DANGER! ARC FLASH and SHOCK HAZARD. FOLLOW ALL REQUIREMENTS IN NFPA70E FOR SAFE WORK PRACTICES and PERSONAL PROTECTIVE EQUIPMENT." The sign shall be prominently mounted on the front of the equipment and readily visible. If the equipment has multiple removable front covers, a sign shall be mounted on each cover. For flush mounted panelboards in finished spaces, the sign shall be mounted on the inside of the door or inside cover. Manufacturers' standard labels are not acceptable.

2.7 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
  - 1. Engraved legend with black letters on white face.
  - 2. Punched or drilled for mechanical fasteners.
  - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

SECTION 26 05 53 –  
IDENTIFICATION FOR ELECTRICAL SYSTEMS

- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.8 EQUIPMENT IDENTIFICATION NAMEPLATES

- A. Engraved, Laminated Acrylic or Melamine Nameplate: Minimum letter height shall be 1/2 inch (13 mm). Refer to Drawings for Nameplate Detail.

- B. Fasteners for nameplates: stainless steel screws that do not change the NEMA or NRTL rating of the enclosure, adhesive labels shall not be used.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

- B. Apply identification devices to surfaces that require finish after completing finish work.

- C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

- D. Attach signs and plastic labels with mechanical fasteners appropriate to the location and substrate.

- E. System Identification Color-Coding Bands for Raceways Larger than Two Inches: Each color coding band shall completely encircle conduit. Locate bands at changes in direction, at penetrations of walls and floors, at 30-foot maximum intervals in straight runs, and within six inches of pull or junction boxes.

- F. System Identification Labels for Raceways carrying circuits above 600V: Locate labels at changes in direction, at penetrations of walls and floors, at 30-foot maximum intervals in straight runs, and within six inches of pull or junction boxes.

SECTION 26 05 53 –  
IDENTIFICATION FOR ELECTRICAL SYSTEMS

G. System Identification Labels for Raceways carrying circuits 600V and less: Locate labels at changes in direction, at penetrations of walls and floors, at 30-foot maximum intervals in straight runs, and within six inches of pull or junction boxes.

H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 18 inches overall. Comply with Section 260543.

I. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend, system voltage, and panel/circuit number. System legends shall comply with Section 260533 – 3.5.D.

1. Normal power.
2. Critical branch power.
3. Life safety power.
4. Equipment branch power.
5. UPS.

B. Power-Circuit Conductor Identification, 600 V or Less: .For conductors in vaults pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors. a. Color shall be factory applied.

b. Colors for 208/120-V Circuits:

- 1) Phase A: Black.
- 2) Phase B: Red.
- 3) Phase C: Blue.

c. Colors for 480/277-V Circuits:

- 1) Phase A: Brown.
- 2) Phase B: Orange.
- 3) Phase C: Yellow.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

SECTION 26 05 53 –  
IDENTIFICATION FOR ELECTRICAL SYSTEMS

- e. For new work in existing buildings, the existing identification method shall be used for new conductors provided it meets all requirements of this Section and the NEC.
  
- C. Install instructional sign including the color code for grounded and ungrounded conductors using adhesive-film-type labels.
  
- D. Emergency Sources: A sign shall be placed at the service entrance equipment indicating the type and location of on-site emergency power sources per NEC Art. 700.
  
- E. Elevator Disconnects: Provide “Fed From” signs indicating the location of the supply side OCPD for each elevator power source.
  
- F. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
  
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
  
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
  - 1. Install underground-line warning tape for both direct-buried cables and cables in raceway.
  
- I. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
  
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked enamel warning signs or Metal-backed, butyrate warning signs.
  - 1. Comply with 29 CFR 1910.145.
  - 2. Identify system voltage.
  - 3. Apply to exterior of door, cover, or other access.
  - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
    - c. Other equipment as indicated on the Drawings.

SECTION 26 05 53 –  
IDENTIFICATION FOR ELECTRICAL SYSTEMS

K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

L. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer and load shedding.

M. Equipment Identification Nameplates: On each unit of equipment, install unique designation nameplate that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply nameplates to Switchgears, Switchboards, Distribution Panels, Panelboards, Motor Control Centers, Transformers, Individual Starters, Contactors, Disconnect Switches, Transfer Switches, Control Panels and Similar Equipment. Systems include power, lighting, and control systems unless equipment is provided with its own identification.

1. Colors for equipment nameplates:
  - a. NORMAL power system: black letters on white background.
  - b. CRITICAL EMERGENCY power system: white letters on red background.
  - c. LIFE SAFETY power system: white letters on red background.
  - d. EQUIPMENT EMERGENCY power system: white letters on red background.
  - e. STANDBY EMERGENCY power system: (dead bus under normal conditions) black letters on yellow background.
2. Labeling Instructions:
  - a. Identify the piece of equipment, the source, voltage characteristics, and the load served
  - b. Indoor Equipment: Engraved, laminated acrylic or melamine nameplate. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
  - c. Outdoor Equipment: Engraved, laminated acrylic or melamine nameplate. Unless otherwise indicated, provide a single line of text with one-inch- (26-mm-) high letters on 3-inch- (76-mm-) high label; where two lines of text are required, use labels 4 inches (100 mm) high.
  - d. Elevated Components: Increase sizes of nameplates and letters to those appropriate for viewing from the floor.
  - e. Fasten nameplates with appropriate stainless steel screws that do not change the NEMA or NRTL rating of the enclosure. Stick-on or adhesives are not acceptable unless the NEMA enclosure rating is compromised, then only epoxy adhesive shall be used to attach nameplates.

**END OF SECTION 26 05 53**

SECTION 26 09 23 –  
LIGHTING CONTROL DEVICES

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

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. Time switches.
2. Exterior photoelectric sensors.
3. Indoor occupancy sensors.
4. Indoor daylight sensors.
5. Wall box dimmers.
6. Emergency relay control devices. (GTD)

a. Related Sections:

1. Section 260519 “Low Voltage Electrical Power Conductors and Cables” for wire and cabling.
2. Section 260936 “Modular Dimming Controls” for localized dimming.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy, photoelectric sensors and emergency relay control devices.
  1. Interconnection diagrams showing field-installed wiring.
  2. Submit typical wiring diagrams for all components including, but not limited to, photosensors, time switches, emergency relay control devices and occupancy sensors.

SECTION 26 09 23 –  
LIGHTING CONTROL DEVICES

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 WARRANTIES

A. Indoor occupancy sensors, photosensors, time switches and emergency relay control devices shall have a standard five (5) year warranty.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including luminaires, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to Authorities Having Jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

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

1. Intermatic, Inc.
2. Cooper Industries, Inc.
3. TORK.

B. Electronic Time Switches: Electronic, solid state programmable units with alphanumeric display; complying with UL 917.

1. Contact Configuration: SPST.
2. Contact Rating: 30A inductive or resistive, 240-V ac.
3. Program: 2 on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.

SECTION 26 09 23 –  
LIGHTING CONTROL DEVICES

5. Astronomic Time: All channels.
  6. Battery Backup: For schedules and time clock.
- C. Color to be white, ivory or grey. Custom colors to be coordinated with the Architect.

## 2.2 EXTERIOR PHOTOELECTRIC SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Lutron.
  2. Leviton.
  3. Hubbell Building Automation.
- B. Description: Solid state, with SPST dry contacts rated for 1800-VA to operate connected load, or contactor coils, complying with UL 773A.
1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
  2. Time Delay: 30-second minimum, to prevent false operation.
  3. Lightning Arrestor: Air gap type.
  4. Mounting: Twist lock complying with IEEE C136.10, with base.

## 2.3 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide products by Lutron Electronics or comparable product approved by Architect.
- B. General Description: Ceiling or wall mounting, solid-state type with a separate relay unit and isolated output.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable in ten (10) minute increments to a maximum setting of sixty (60) minutes.
  2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  4. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

SECTION 26 09 23 –  
LIGHTING CONTROL DEVICES

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the 'on' function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.
8. Sensors shall be UL listed.
9. Communications capability with daylighting function.
10. Five year warranty.
11. Fully compatible with lighting control system/dimming system and shall communicate with said system.
12. Color to be white, ivory or grey. Custom colors to be coordinated with the Architect.

C. Dual-Technology Low Voltage Type with Power Pack: Ceiling or wall mounting; detect occupancy/vacancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): 360° coverage, detect occupancy anywhere in the following areas when mounted on a 96-inch high ceiling.
  - a. Up to 1000 sq. ft. for normal range.
  - b. Up to 2000 sq. ft. for extended range.
4. Operating Environment: Operating temperature 32°-104°F with a relative humidity (noncondensing) of 0% to 95%.
5. Color to be white, ivory or grey. Custom colors to be coordinated with the Architect.

D. Dual-Technology Line Voltage Dual Relay Type: Wall mounted for dual level control; detect occupancy/vacancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): 180° coverage, detect occupancy anywhere in the following areas when mounted on wall.
  - a. Up to 225 sq. ft. for utilizing dual technology.

SECTION 26 09 23 –  
LIGHTING CONTROL DEVICES

4. Operating Environment: Operating temperature 32°-104°F with a relative humidity (noncondensing) of 0% to 95%.
5. Dual Relay.
6. Dual button.
7. Color to be white, ivory or grey. Custom colors to be coordinated with the Architect.

2.4 INDOOR DAYLIGHT SENSORS

A. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide products by Lutron Electronics or comparable product approved by the Architect.

B. Ceiling-Mounted Daylight Sensor: Solid-state, light-level sensor unit with photodiode element to detect changes in lighting levels that are perceived by the eye, sensing daylight and electrical lighting levels. The unit adjusts the indoor electrical lighting levels.

1. Sensor Output: Provide data to the dimming ballast or step dimming ballast for adjusting light levels. As daylight increases, the lights are reduced.
2. Power supply to sensor shall be 24-V dc, 150-mA, and Class 2 power source as defined by NFPA 70.
3. Open loop basis for daylight sensor control scheme.
4. Partially shielded for accurate detection of available daylight to prevent luminaire lighting and horizontal light component from skewing sensor detection.
5. Light-Level Monitoring Range: 0 to 500 fc, with an adjustment for turn-on and turn-off levels within that range.
6. Time Delay: Adjustable in ten (10) minute increments to a maximum setting of sixty (60) minutes.
7. Low voltage class 2 wiring for low voltage communication.
8. Indicator: LED's to indicate operation and programming mode.
9. Sensor shall be capable of being mounted in ceiling tile or luminaire.
10. Sensor shall have the ability to be replaced without reprogramming.
11. UL listed.
12. Five year warranty.
13. Fully compatible with lighting control system/dimming system and shall communicate with said system.

2.5 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

1. Manufacturers: Subject to compliance with requirements, provide the following:
  - a. Lutron.

B. Control: Continuously adjustable slide-to-off with single-pole or three-way switching. Comply with UL 1472.

SECTION 26 09 23 –  
LIGHTING CONTROL DEVICES

- C. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.
- D. Fully compatible with lighting control system/dimming system and shall communicate with said system.
- E. Color to be white, ivory or grey. Custom colors to be coordinated with the Architect.

2.6 EMERGENCY RELAY CONTROL DEVICE

- A. Internal Type: Self contained, modular, emergency power transfer device, factory mounted or field mounted within luminaire body and compatible with ballast, as manufactured by The Bodine Company, Model GTD or approved equal by the Architect.
  - 1. Emergency Connection: Operate one (1) ballast within fluorescent luminaire continuously under emergency conditions regardless of wall switch position. Connect unswitched normal and emergency circuits, and switched normal circuit to transfer device. Output to one (1) AC ballast.
  - 2. Fused input.
  - 3. Rated for 3 amps, 120/277 volts.
- B. External Type: Where control of multiple luminaires is indicated, externally mounted type unit as manufactured by The Bodine Company, GTD20 or approved equal by the Architect.
  - 1. Fused input.
  - 2. Rated for 20 amps, 120/277 volts.
- C. All devices shall be warranted for five (5) full years after date of purchase.
- D. UL 924 Listed.

2.7 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

SECTION 26 09 23 –  
LIGHTING CONTROL DEVICES

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including luminaires, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions. Allow six (6) feet of cable slack for sensor location adjustment.

C. Dimmers:

1. Install dimmers within terms of their listing.
2. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 3/4 inch.

B. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

SECTION 26 09 23 –  
LIGHTING CONTROL DEVICES

- B. Lighting control devices that fail tests and inspections are defective Work.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26.

END OF SECTION 26 09 23

SECTION 26 24 16 –  
PANELBOARDS

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Electronic-grade panelboards.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. SPD: Surge Protective Device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, surge suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

SECTION 26 24 16 –  
PANELBOARDS

1.5 INFORMATIONAL SUBMITTALS

- A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Keys: Two spares for each type of panelboard cabinet lock.

1.9 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- 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. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.11 PROJECT CONDITIONS

SECTION 26 24 16 –  
PANELBOARDS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).

b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

2. Altitude not exceeding 6600 feet (2000 m).

1.12 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.13 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

SECTION 26 24 16 –  
PANELBOARDS

- a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
  - b. Outdoor Locations: NEMA 250, Type 3R.
  - c. Kitchen, Food Service and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
  - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
  - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  3. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  4. Finishes:
    - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pre-treating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.
    - c. Fungus Proofing: [*FOR TROPICAL LOCATIONS*] Permanent fungicidal treatment for overcurrent protective devices and other components.
  5. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- B. Incoming Mains Location: Top or bottom.
- C. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
  4. Fully rated Neutral bus.
  5. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Main and Neutral Lugs: Mechanical type.
  3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  5. Sub-feed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
  6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

SECTION 26 24 16 –  
PANELBOARDS

7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extracapacity neutral bus.

E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

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

1. Eaton Corp. Electrical Group.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Lugs as shown on One Line Diagram.

E. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

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

1. Eaton Corp. Electrical Group.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuits interrupting rating as panelboard.

SECTION 26 24 16 –  
PANELBOARDS

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 ELECTRONIC-GRADE PANELBOARDS

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

1. Eaton Corp. Electrical Group.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1; with factory-installed, integral TVSS; labeled by an NRTL for compliance with UL 67 after installing TVSS.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

D. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

E. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

F. Buses:

1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
2. Copper equipment and isolated ground buses.

G. Surge Protection Device: IEEE C62.41-compliant, externally mounted, complying with UL 1449, 3rd edition and Specification 264313.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes up to 250 A.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front mounted, field-adjustable trip setting.

SECTION 26 24 16 –  
PANELBOARDS

3. Electronic trip circuit breakers with RMS sensing; field-replaceable rating plug or field replicable electronic trip for circuit-breaker frame sizes 250 A and larger; and the following field-adjustable settings:
  - a. Instantaneous trip.
  - b. Long- and short-time pickup levels.
  - c. Long- and short-time time adjustments.
  - d. Ground-fault pickup level, time delay, and  $I^2t$  response.
4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Single- and two-pole configurations with Class B ground-fault protection (30-mA trip).
6. Multi-pole circuit breakers shall have common trip, use of handle ties is not permitted.
7. Standard frame sizes, trip ratings, and number of poles.
8. Application Listing: Appropriate for application. (e.g. HACR, SWD)
9. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
10. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
  - a. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  - b. Communication Capability: Communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
  - c. Shunt Trip: 120 -V trip coil energized from separate circuit.
  - d. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field adjustable 0.1- to 0.6-second time delay.
  - e. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit breaker contacts.
  - f. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
  - g. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
  - h. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
  - i. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handles in on or off position.
  - j. Handle Clamp: Loose attachment, for holding circuit-breaker handles in on position.

2.6 PANELBOARD SUPPRESSORS

SECTION 26 24 16 –  
PANELBOARDS

- A. Subject to compliance with requirements, Surge Protection Devices shall be IEEE C62.41 compliant, externally mounted, and complying with UL 1449, 3rd edition and Specification 264313.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Wall Mounted Panelboards: Do not attach directly to walls or structural surfaces. Attach panelboard to the vertical finished or structural surface behind the panelboard on channels such as “Unistrut”.
- C. Floor Mounted Panelboards: Install panelboards on 4 inch high concrete bases. Comply with requirements for concrete base specified in Division 03 Sections.
  - 1. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 2. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 3. Install anchor bolts to elevations required for proper attachment to panelboards.
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- G. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box. H. Install overcurrent protective devices and controllers not already factory installed.
- I. Provide GFI circuit breakers with 30 mA sensitivity trip for all freeze protection, temperature maintenance, and heat tracing circuits. J. Install filler plates in unused spaces.

SECTION 26 24 16 –  
PANELBOARDS

- K. Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.
- L. Stub six 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- M. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- N. Comply with NECA 1.
- O. New circuit breakers installed in existing panelboards shall be of standard manufacture, shall match existing, and shall have an interrupting rating of not less than the lowest rated circuit breaker in the panelboard.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

- 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
- 2. Test continuity of each circuit.
- 3. Comply with NETS.

B. Tests and Inspections:

- 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

SECTION 26 24 16 –  
PANELBOARDS

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each panelboard. Remove front so joints and connections are accessible to portable scanner.

1. Instrument: Use an infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

2. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and that describes infrared-scanning results. Include notation of deficiencies detected, remedial actions taken, and observations after remedial action.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.5 CLEANING

A. Vacuum dirt and debris from panelboard tubs; do not use compressed air to assist in cleaning.

3.6 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.

2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.

4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.7 PROTECTION

SECTION 26 24 16 –  
PANELBOARDS

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 26 27 15 –  
METER CENTERS AND METER STACKS

SECTION 26 27 15 - METER CENTERS AND METER STACKS

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and install the meter centers as specified herein and as shown on the contract drawings.

1.02 RELATED SECTIONS

- A. Section 26 28 11 – Circuit Breakers and Fusible Switches – Low Voltage

1.03 REFERENCES

- A. The meter centers and all components shall be designed, manufactured and tested in accordance with the latest applicable following standards:
  - 1. UL 67
  - 2. UL 869
  - 3. UL 486B

1.04 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:
  - 1. Master drawing index
  - 2. Front view elevation
  - 3. Floor plan
  - 4. Single line
  - 5. Schematic diagram
  - 6. Component list
  - 7. Conduit entry/exit locations
  - 8. Assembly ratings including:
    - a. Short-circuit rating
    - b. Voltage
    - c. Continuous current
  - 9. Major component ratings including:
    - a. Voltage
    - b. Continuous current
    - c. Interrupting ratings
  - 10. Cable terminal sizes

1.05 SUBMITTALS – FOR CONSTRUCTION

- A. The following information shall be submitted for record purposes:
  - 1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process

SECTION 26 27 15 –  
METER CENTERS AND METER STACKS

- 2. Wiring diagrams
- 3. Installation information

1.06 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.07 REGULATORY REQUIREMENTS

- A. The meter centers shall be UL labeled.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.09 FIELD MEASUREMENTS

1.10 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
- B. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
- C. Square D; a brand of Schneider Electric.

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

SECTION 26 27 15 –  
METER CENTERS AND METER STACKS

2.02 RATINGS

- A. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current 65,000 amperes symmetrical at rated voltage.

2.03 CONSTRUCTION

- A. The entire assembly shall be front accessible and shall include main lugs.
- B. Tenant disconnects shall be wired for hot sequence and shall be molded case circuit breakers.
- C. The meter sockets shall be ringless type rated as shown on the plans and a bypass shall not be required. The meter sockets and associated branch protective device positions shall be completely pre-wired and shipped ready for installation of the meters and tenant main breakers. Meter sockets shall include covers with sealing provisions.

2.04 BUS

- A. All bus bars shall be tin-plated aluminum. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on UL standard temperature rise criteria for multi-metering equipment.
- B. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.
- C. All hardware used for aluminum bus bar connections shall be high-tensile strength, zinc-plated. Provide Belleville-type spring washers for all bus joints.

2.05 WIRING/TERMINATION

- A. Mechanical-type terminals shall be provided for all line terminations suitable for copper or aluminum cable and rated at 75 degrees C.
- B. Lugs shall be provided in the incoming line section for connection of the main grounding conductor.

2.06 TENANT UTILITY METERING

- A. For NATIONAL GRID serviced areas, meter centers shall incorporate metering sections with tenant feeder circuits using ring-type meter sockets rated 125 amperes to meet local utility and/or customer requirements.
- B. The self-contained meter sockets shall include a test bypass/disconnect block per NATIONAL GRID requirements,

2.07 ENCLOSURES

- A. NEMA 1 Enclosure

2.08 FINISH

- A. Boxes and trims shall be primed and finished with ANSI 61 light gray enamel.

PART 3 EXECUTION

3.01 FACTORY TESTING

SECTION 26 27 15 –  
METER CENTERS AND METER STACKS

- A. Standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

3.02 FIELD QUALITY CONTROL

3.03 MANUFACTURER'S CERTIFICATION

3.04 TRAINING

- A. The Contractor shall provide a training session for up to two (2) owner's representatives for up to 4 hours at the job site location.
- B. A manufacturer's qualified representative shall conduct the training session. The training program shall consist of instruction on the operation of the assembly, circuit breakers, fused switches, meters, and major components within the assembly.

3.05 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.
- B. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

END OF SECTION 26 27 15

SECTION 26 27 26 –  
WIRING DEVICES

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. “Lighting Control Devices” for wall box dimmers and wall box occupancy sensors.

1.2 SUMMARY

A. Section Includes:

- 1. Receptacles, receptacles with integral GFCI, and associated device plates.
- 2. Twist-locking receptacles.
- 3. Isolated-ground receptacles.
- 4. Tamper-resistant receptacles.
- 5. Weather-resistant receptacles.
- 6. Pendant cord-connector devices.
- 7. Cord and plug sets.
- 8. Toggle Switches.
- 9. Wall switch occupancy sensors.
- 10. Floor service outlets.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Cord and Plug Sets: Match equipment requirements.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by UL and marked for intended location and application.

SECTION 26 27 26 –  
WIRING DEVICES

B. Comply with NFPA 70.

C. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

1.7 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: UL listed and labeled as defined in NFPA 70 and marked for intended location and application.

B. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.2 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Heavy duty specification grade complying with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

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

- a. Cooper; 5351 (single), CR5362 (duplex).
- b. Hubbell; HBL5351 (single), HBL5352 (duplex).
- c. Pass & Seymour; 5361 (single), 5362 (duplex).
- d. Leviton Mfg. Company; 5891(single), 5352 (duplex).

SECTION 26 27 26 –  
WIRING DEVICES

2.3 GFCI RECEPTACLES

A. General Description:

1. Straight blade, non-feed through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943, Class A, and FS W-C-596.
3. Include correct wiring/trip indicator light.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; VGF20.
  - b. Hubbell; GFR5352L.
  - c. Pass & Seymour; 2095.
  - d. Leviton Mfg. Company; 7590.

C. Tamper-Resistant GFCI, Duplex Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Hubbell; GFTR20.
  - b. Pass & Seymour; 2095TR.

2.4 RECEPTACLES FOR SPECIAL EQUIPMENT

2.5 TWIST-LOCKING RECEPTACLES

A. Single Receptacles, 125 V, 20 A for use in Isolated Power System Panels: Locking Type.

1. Products: Subject to compliance with requirements, provide the following:
  - a. Hubbell: 23000.

B. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6, Configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; CWL520R.
  - b. Hubbell; HBL2310.
  - c. Pass & Seymour; L520-R.
  - d. Leviton Mfg. Company; 2310.

C. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; IGL520R.
  - b. Hubbell; IG2310.

SECTION 26 27 26 –  
WIRING DEVICES

- c. Pass & Seymour; IG4700.
- d. Leviton Mfg. Company; 2310-IG.

2. Description:

- a. Comply with NEMA WD 1, NEMA WD 6, Configuration L5-20R, and UL 498.
- b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.6 PENDANT CORD-CONNECTOR DEVICES

A. Description:

- 1. Matching, locking-type plug and receptacle body connector.
- 2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
- 3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
- 4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.7 CORD AND PLUG SETS

A. Description:

- 1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- 2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
- 3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.8 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

- 1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Single Pole:

SECTION 26 27 26 –  
WIRING DEVICES

- 1) Cooper; AH1221.
- 2) Hubbell; HBL1221.
- 3) Pass & Seymour; CSB20AC1.
- 4) Leviton Mfg. Company; 1221-2.

b. Two Pole:

- 1) Cooper; AH1222.
- 2) Hubbell; HBL1222.
- 3) Pass & Seymour; CSB20AC2.
- 4) Leviton Mfg. Company; 1222-2.

c. Three Way:

- 1) Cooper; AH1223.
- 2) Hubbell; HBL1223.
- 3) Pass & Seymour; CSB20AC3.
- 4) Leviton Mfg. Company; 1223-2.

d. Four Way:

- 1) Cooper; AH1224.
- 2) Hubbell; HBL1224.
- 3) Pass & Seymour; CSB20AC4.
- 4) Leviton Mfg. Company; 1224-2. C. Pilot-Light Switches, 20 A:

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

- a. Cooper; AH1221PL for 120 and 277 V.
- b. Hubbell; HBL1201PL for 120 and 277 V.
- c. Pass & Seymour; PS20AC1RPL for 120 V, PS20AC1RPL7 for 277 V.
- d. Leviton Mfg. Company; 1221-LH1.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off." D. Key Operated Switches, 120/277 V, 20 A:

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

- a. Cooper; AH1221L.
- b. Hubbell; HBL1221L.
- c. Pass & Seymour; PS20AC1-L.
- d. Leviton Mfg. Company; 1221-2L.

2. Description: Single pole, with factory-supplied key in lieu of switch handle. Provide six (6) spare keys.

2.10 WALL BOX OCCUPANCY SENSORS

A. Line voltage dual technology wall-switch sensors with power pack:

SECTION 26 27 26 –  
WIRING DEVICES

1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Watt Stopper (The) DW-100- Dual Technology.
    - b. Hubbell.
    - c. Leviton.
  2. Description: Line Voltage Dual Technology type, 120/230/277 VAC, adjustable time delay up to 30 minutes, 180-degree field of view, UL Listed with a minimum PIR coverage area of 300 sq. ft and a minimum UV coverage area of 225 sq. ft.
  3. Operating Environment: Operating temperature 32-104 degrees F with a relative humidity (non-condensing) of 0% to 95%.
  4. Finish: White
  5. Warranty: 5 Years
- B. Line voltage dual technology dual relay wall-switch sensors.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Watt Stopper (The) DW 200 - Dual Technology dual relay output.
    - b. Hubbell.
    - c. Leviton.
  2. Description: Line voltage dual technology type, 120/230/277 VAC, adjustable time delay up to 30 minutes, 180-degree field of view, UL listed with a minimum PIR coverage area of 300 sq. ft. and a minimum UV coverage area of 225 sq. ft. Contains two relays.
  3. Operating Environment: Operating temperature 32-104 degrees F with a relative humidity (non-condensing) of 0% to 95%.
  4. Two relays.
  5. Dual on/off buttons.
  6. Finish: White
  7. Warranty: 5 Years.

2.11 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces:
    - a. Offices and administrative areas: Smooth, flexible, thermoplastic nylon.
  3. Material for Unfinished Spaces: 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel.
  4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
  5. Receptacles for use with computers: Use engraved machine printing with 0.188" high black-filled lettering on face of plate to read "COMPUTER ONLY".

SECTION 26 27 26 –  
WIRING DEVICES

B. Wet-Location, Weatherproof-in-use Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.12 FLOOR SERVICE FITTINGS

- A. Coordinate fittings with floor boxes as described in Section 260533.
- B. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- C. Compartments: Barrier separates power from voice and data communication cabling.
- D. Service Plate: Rectangular die-cast aluminum with satin finish.
- E. Power Receptacle: NEMA WD 6 Configuration 5-20R, unless otherwise indicated.
- F. Voice and Data Communication Outlet: Comply with Owner's Standards.

2.13 FINISHES

- A. Device Color:
  - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
  - 2. Wiring Devices Connected to Emergency Power System: Red.
  - 3. Isolated-Ground Receptacles: Orange.
  - 4. UPS: Blue.
- B. Wall Plate Color: For non-metallic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

SECTION 26 27 26 –  
WIRING DEVICES

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
  - a. Cut back and pigtail, or replace all damaged conductors.
  - b. Straighten conductors that remain and remove corrosion and foreign matter.
  - c. Pig-tailing existing conductors are permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. “Daisy-chaining” of receptacles is not permitted.
6. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
7. Use a torque screwdriver when a torque is recommended or required by manufacturer.
8. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
9. Tighten unused terminal screws on the device.
10. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

SECTION 26 27 26 –  
WIRING DEVICES

- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- H. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped or engraved machine printing with white-filled lettering on black field, self adhesive nameplate attached to face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Test Instruments: Use instruments that comply with UL 1436.
  - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Convenience Receptacles:
  - 1. Line Voltage: Acceptable range is 105 to 132 V.
  - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
  - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
  - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
  - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Test straight-blade commercial-grade convenience outlets for the retention force of the grounding blade. Retention force shall be not less than 4 oz. (115 g).
- D. Wiring device will be considered defective if it does not pass tests and inspections.

SECTION 26 27 26 –  
WIRING DEVICES

- E. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 28 13 –  
FUSES

SECTION 26 28 13 - FUSES

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. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, enclosed controllers, and motor-control centers.
2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
  - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
  - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include the following:

1. Ambient temperature adjustment information.

2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
4. Coordination charts and tables and related data.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three (3) of each size and type.

#### 1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by UL and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

#### 1.7 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

#### 1.8 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

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

1. Cooper Bussmann, Inc.

2. Mersen USA (Ferraz Shawmut)

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

## 2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

## 2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and keycoded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: Provide for each size of fuse.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
  1. Motor Branch Circuits: Class RK1, time delay.

2. Other Branch Circuits: Class RK1, time delay.
3. Control Circuits: Class CC, time delay.

### 3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in electric rooms and mechanical rooms, stock with spares and fuse pullers.

### 3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, and holder.

END OF SECTION 26 28 13

## SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:

1. Fusible switches.
2. Non-fusible switches.
3. Shunt trip switches.
4. Molded-case circuit breakers (MCCBs).
5. Molded-case switches.
6. Enclosures.

- B. Related Sections:

1. Division 26 Section "Electrical Power Monitoring and Control" for interfacing communication and metering requirements.

##### 1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
5. Include time-current coordination curves (average melt) for each type and rating of

## SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- B. Manufacturer's field service report.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
  - 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses no fewer than three (3) of each size and type.
  - 2. Fuse Pullers: one for each size and type.

### 1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

## SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by UL and marked for intended location and application.
- D. Comply with NFPA 70.

### 1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
  - 2. Altitude: Not exceeding 6600 feet (2010 m).
  - 3. Comply with NFPA 70E.

### 1.10 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## PART 2 - PRODUCTS

### 2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, [240] [600]-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

## SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.
8. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

### 2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
  5. Lugs: Mechanical type, suitable for number, size, and conductor material.
  6. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

### 2.3 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Cooper Bussmann, Inc.
  2. Mersen USA (Ferraz Shawmut, Inc.)
  3. Eaton Corp. Electrical Group.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

## SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
- E. Accessories:
  - 1. Oiltight key switch for key-to-test function.
  - 2. Oiltight red ON pilot light.
  - 3. Isolated neutral lug; 100 percent rating.
  - 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
  - 5. Form C alarm contacts that change state when switch is tripped.
  - 6. Three-pole, double-throw, fire-safety and alarm relay; 120-V coil voltage.
  - 7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

### 2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Corp. Electrical Group.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Square D; a brand of Schneider Electric.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A up to 400 A.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: 400 A and larger. Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
  - 1. Instantaneous trip.
  - 2. Long- and short-time pickup levels.
  - 3. Long- and short-time time adjustments.
  - 4. Ground-fault pickup level, time delay, and  $I^2t$  response.
- F. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations

## SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

with Class A ground-fault protection (6-mA trip).

- G. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: Single- and two-pole configurations with Class B ground-fault protection (30-mA trip).
- H. Features and Accessories:
  - 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
  - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
  - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
  - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
  - 6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
  - 7. Electrical Operator: Provide remote control for on, off, and reset operations.
  - 8. Accessory Control Power Voltage: Integrally mounted, self-powered.

### 2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R.
  - 3. Kitchen, Wash-Down Areas, Other Wet or Damp Indoor Locations: NEMA 250, Type 4X, stainless steel.
  - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless

## SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

otherwise indicated.

- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- A. Install wiring between circuit breakers and switches, and facility's EPMC system. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Install fuses in fusible devices in accordance with Division 26 Section "Overcurrent Protective Device Coordination Study".
- C. Provide GFI circuit breakers with 30 mA sensitivity trip for all freeze protection, temperature maintenance, and heat tracing circuits.
- D. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved laminated-plastic nameplate.

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

## SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each device. Remove front and rear panels so joints and connections are accessible to portable scanner.
  - 1. Instrument: Use an infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 2. Record of Infrared Scanning: Prepare a certified report that identifies devices checked and that describes infrared-scanning results. Include notation of deficiencies detected, remedial actions taken, and observations after remedial action.
- E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection report, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study".

END OF SECTION 26 28 16

SECTION 265100 –  
INTERIOR LIGHTING

SECTION 265100 - INTERIOR LIGHTING

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. Interior luminaires and lamps.
2. Emergency lighting units.
3. Exit signs.
4. Luminaire supports.

B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photosensors, occupancy sensors, and lighting relays and contactors, manual wall box dimmers.
2. Section 260936 "Modular Dimming Controls" for localized dimming.
3. Section 260519 "Low Voltage Electrical Power Conductors and Cables" for wire and cabling.

1.3 SYSTEM DESCRIPTION

A. Catalog numbers indicated in the Luminaire Schedule are a design series reference and do not necessarily represent the exact catalog number, size, voltage, wattage, type of lamp, ballast, finish trim, ceiling type, mounting hardware or special requirements as specified or as required by the particular installations. Provide complete luminaire to correspond with the features, accessories, number of lamps, wattage and/or size specified in the text description of each luminaire type. Additional features, accessories and options specified shall be included.

B. Provide all frames, supplementary support structures, hangers, spacers, stems, aligner canopies, auxiliary junction boxes and other hardware as required for a complete and proper installation. Recessed luminaires shall have frames that are compatible with the ceiling systems.

C. Luminaire voltage shall match the voltage of the circuit serving same.

1.4 DEFINITIONS

SECTION 265100 –  
INTERIOR LIGHTING

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.5 SUBMITTALS

- A. Product Data: For each type of luminaire, arranged in order of luminaire designation. Include data on features, accessories, finishes, and the following:
  - 1. Material and physical description of luminaire including dimensions.
  - 2. Emergency lighting units including battery and charger.
  - 3. Ballast, including BF.
  - 4. Energy-efficiency data.
  - 5. Air and Thermal Performance Data: For air-handling luminaires. Furnish data required in "Action Submittals" Article in Section 233713 "Diffusers, Registers, and Grilles."
  - 6. Sound Performance Data: For air-handling luminaires. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Section 233713 "Diffusers, Registers, and Grilles."
  - 7. Life, output (lumens, CCT, and CRI), Kelvin temperature, and energy-efficiency data for lamps.
  - 8. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the luminaire as applied in this Project.
    - a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer. LM-79 and LM-80 data for solid state lighting.
    - b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
  - 9. Photometric data, certified by a qualified independent testing agency, in IESNA format, based on certified results of laboratory tests of each luminaire type,

SECTION 265100 –  
INTERIOR LIGHTING

outfitted with lamps, ballasts and accessories identical to those indicated for the luminaire as applied in the Project.

10. Low voltage transformers.
  11. Fluorescent and high intensity discharge ballasts.
  12. LED power supplies.
- B. Shop Drawings shall:
1. Show detail of nonstandard or custom luminaires.
  2. Indicate dimensions, weights, method of field assembly, components, features and accessories.
  3. For custom luminaires, modified luminaires or linear fluorescent luminaires mounted in continuous rows, submit scaled drawings prepared by the manufacturer showing all details of construction, lengths in runs, pendant or power feed locations, accessories, finishes and lists of materials.
  4. This Contractor shall provide the manufacturer with accurate field dimensions where required.
  5. Include wiring diagrams, power and control wiring.
- C. Wiring diagrams shall detail wiring for luminaires and differentiate between manufacturer installed and field installed wiring.
- D. Product Certificates shall be signed by manufacturers of luminaires certifying that products comply with requirements.
- E. Dimming Ballast Compatibility Certificates shall be signed by the manufacturer of ballast certifying that ballasts are compatible with dimming systems and equipment with which they are used. Product Certificates signed by product manufacturer shall be provided for each type of ballast for bi-level and dimmer controlled luminaires.
- F. Maintenance Data shall be provided for luminaires and equipment to include in emergency, operation and maintenance manuals specified in specifications section describing Operations and Maintenance Data.
- G. Field quality control test reports.
- H. Special Warranties specified in the Section.
- I. Review of luminaire submittals which indicate voltage, mounting condition, or quantities shall not be considered to be approval of said voltage, mounting condition or quantities. This Contractor shall field verify voltage and actual mounting condition and method.
- J. Product samples, complete with housing, trim, specified lamp and 8' cord with plug shall be submitted if requested.

1.6 CUSTOM LUMINAIRES

A. All custom luminaires require a prototype to be submitted prior to commencement of fabrication. The purpose of the prototype will be to review construction, lamp placement within luminaire, lamp type, optical assembly, finishes, etc. Modifications may be required as a result of prototype review. These

SECTION 265100 –  
INTERIOR LIGHTING

modifications and others that do not materially affect the cost of the luminaire shall be incorporated at no additional cost to the Owner, Architect or Architect/Engineer.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and luminaires to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 5% of each type and rating installed. Furnish at least one of each type.
2. Glass, Plastic Diffusers and Lenses: 10% or one dozen (whichever is less) of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: 5% of each type and rating installed. Furnish at least one of each type.
4. Adjustable accent lights (track, recessed or surface mounted): One case or 20% (whichever is less) of each lamp type. A spot distribution and a flood distribution are considered to be two different lamp types. 10% or one dozen (whichever is less) additional lenses, color filters, louvers, and other accessories to be used during final focusing.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver luminaires individually wrapped in factory fabricated fiberboard type containers. Parabolic louvers shall be shipped in thermally sealed polyethylene wrapper.
- B. Handle luminaires carefully to prevent breakage, denting and scouring of the luminaire finish.
- C. Store product in a clean, dry space, protected from weather.

1.10 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the Authorities Having Jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

SECTION 265100 –  
INTERIOR LIGHTING

D. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated Class and Division of hazard by FM Global.

E. Designated manufacturers are listed to define the requirements for quality and function of the specified product.

F. Mockups: Provide interior luminaires for room or module mockups, complete with power and control connections.

1. Obtain Lighting Designer's and Architect's approval of luminaires for mockups prior to starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Remove mockups when directed. Luminaires may be reinstalled in the Work with approval from the Owner.
4. Install luminaires for mockups with power and control connections.
5. Mockups evaluated on the Project site may become part of the complete Work with the approval of the Owner, Lighting Designer and Architect if the mockup is undisturbed at the time of substantial completion.

1.11 COORDINATION

A. Coordinate layout and installation of luminaires with ceiling system and other construction that penetrates ceilings or is supported by them including mechanical system, fire suppression, and technology and partition assemblies.

B. Provide all frames, supplementary support structures, hangers, spacers, stems, aligner canopies, auxiliary junction boxes and other hardware as required for a complete and proper installation. Recessed luminaires shall have frames that are compatible with the ceiling system.

C. Coordination Meetings: This Contractor shall meet at least twice with the ceiling installer. Hold first meeting before submittal of shop drawings to coordinate each luminaire mounting condition with ceiling type. During second meeting, coordinate luminaire layout in each area. This Contractor shall meet at least twice with the mechanical systems installer prior to fabrication and installation of ductwork. Coordinate depth and location of all luminaires with ductwork, fire suppression, and technology in all areas.

1.12 WARRANTY

A. General Warranty: Special warranty specified in this Section shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by this Contractor under requirements of the Contract Documents.

B. Special Warranties for Fluorescent Ballasts: Written warranty, executed by manufacturer agreeing to replace fluorescent ballasts if they fail in material or workmanship within specified warranty period.

SECTION 265100 –  
INTERIOR LIGHTING

1. Special Warranty Period for Electronic Ballasts: Five years from date of substantial completion.
  2. Special Warranty Period for Electromagnetic Ballasts: Three years from date of substantial completion.
- D. Special Warranty for LEDs' and Drivers: Manufacturers standard form in which manufacturer of LED's and drivers agrees to replace components that fails in materials or workmanship within specified warranty period.
1. LED arrays: 5 years from date of substantial completion.
  2. Drivers: 5 years from date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES AND COMPONENTS

- A. Recessed Luminaires: Comply with NEMA LE 4 for ceiling compatibility for recessed luminaires.
- B. Metal Parts: Free of burrs, sharp corners and edges. Metal work shall be free of tool marks and dents and shall have accurate angles bent as sharply as compatible with the gauges of the required metal. Intersections and joints shall be formed true and of adequate strength and structural rigidity to prevent any distortion after assembly. All miters shall be in accurate alignment with abutting intersection members.
- C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging. Luminaires to be painted after fabrication. Finish ferrous mounting hardware and accessories to prevent corrosion and discoloration to adjacent materials.
- D. Luminaire hardware to comply with the following material standards: For steel and aluminum luminaires, all screws, bolts, nuts and other fastening and latching hardware shall be cadmium or equivalent plated. For stainless steel luminaires, all hardware shall be stainless steel. For bronze luminaires, all hardware shall be stainless steel or bronze, unless otherwise noted.
- K. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Safety devices shall be detachable if necessary and shall not interfere with luminaire performance, maintenance

SECTION 265100 –  
INTERIOR LIGHTING

or the seating of any luminaire element. Safety device shall not be visible during normal luminaire operation and from normal viewing angles.

- L. Luminaires provided shall have means for disconnection from power source during service, as required in NEC Article 410.
- M. Reflecting Surfaces: Minimum reflectance as follows, unless indicated otherwise:
  - 1. White Surfaces: 85%
  - 2. Specular Surfaces: 90%
  - 3. Diffusing Specular Surfaces: 75%
- N. Reflector cones shall adhere to the following:
  - 1. Cones designed for vertically mounted lamps shall provide a minimum of 45 degree cutoff of lamp and lamp image. Cones designed for horizontally mounted lamps shall provide a minimum of 55 degree cutoff of lamp and lamp image. These shall be no visible lamp flashing in the cone.
  - 2. Plastic material shall not be used for reflector cones, unless otherwise specified.
  - 3. Cones shall not be permanently fastened to the housing of ceiling and shall be removable without tools. Retention devices shall not deform the cone or be visible from normal viewing angles.
  - 4. Trim shall be flush to ceiling without gaps or light leaks. Where the flange trim is separate from the cone, it shall have the same finish as the reflector cone. Cones with parabolic cross louvers shall be parallel and perpendicular to adjacent walls.
  - 5. Reflector cones shall be uniform gauge, not less than 0.032" thick, high purity aluminum Alcoa 3002 alloy. Cones shall be free from spin marks or other defects.
  - 6. Manufacture cone using the Alzak process. Refer to Luminaire Schedule for cone color and finish, i.e., specular or diffuse requirements. For compact fluorescent luminaires, finish shall eliminate iridescence.
- O. Lenses, Covers, Diffusers and Globes:
  - 1. Acrylic Lighting Diffusers: 100% virgin acrylic plastic. UV stabilized, high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
    - b. Lenses shall have uniform brightness throughout the entire visible area.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
- P. Adjustable luminaires shall have positive locking devices to fix aiming angle. Luminaires shall be capable of being relamped without adjusting aiming angle.
- Q. Each luminaire that has a lamp with an oval shape beam pattern or a spread lens that defines beam orientation shall contain lamp or lens locking devices to insure that lamp or lens orientation is not disturbed during lamp replacement or cleaning.
- R. All luminaires and ballasts shall operate within the temperature limits of their design and as specified by UL in the applications and mounting conditions specified.

SECTION 265100 –  
INTERIOR LIGHTING

- S. Luminaires recessed in suspended ceilings where the space above the ceiling is either an air supply or return plenum shall conform to NEC Article 300-22.
- T. Provide plaster frame for recessed luminaires mounted in other than T-bar ceilings. Verify mounting with architectural reflected ceiling plan before ordering luminaires. U. Provide wire guards on all fluorescent open strip type luminaires.
- V. For weatherproof or vapor tight installations, painted finishes of luminaires and accessories shall be weather resistant enamel using proper primers or galvanized and bonded epoxy, so that the entire assembly is completely corrosion resistant for the service intended. Exterior finishes shall have an outdoor life expectancy of not less than 20 years without any visible rust or corrosion. Where aluminum parts come in contact with bronze or steel parts, apply a coating material to both surfaces to prevent corrosion.
- W. Luminaires for use outdoors or in areas designated as damp locations shall be suitable gasketed to prevent the entrance of moisture. Provide approved wire mesh screens for ventilation openings. Dissimilar metals shall be separated by non-conductive material to prevent galvanic action.
- X. Electromagnetic-Interference Filters shall be factory installed on all surgical grade luminaires to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate luminaires with one filter for each ballast indicated to require a filter.
- Y. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp and ballast characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter code (T-5, T-8, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
    - d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
    - e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
    - f. CCT and CRI for all luminaires.

2.3 LED LUMINAIRES AND DRIVERS

- A. All Luminaires
  - 1. Comply with IES LM-79-08 Approved Method for measuring lumen maintenance of LED light sources.
  - 2. Comply with IES LM-80-08 Approved Method for electrical and photometric measurement of SSL product.
  - 3. Comply with In-Situ testing for more reliable results.

SECTION 265100 –  
INTERIOR LIGHTING

4. LED's shall be Restriction of Hazardous Substances Directive (RoHS) compliant.
5. LED arrays shall be sealed, high performance, long life type; minimum 70% rated output at 50,000 hours.
6. LED luminaires shall deliver a minimum of 60 lumens per watt.
  - a. LED's shall be "Bin No. 1" quality.
7. Drivers shall be solid state and accept 120 through 277 VAC at 60 Hz input.
8. The LED light source shall be fully dimmable with use of compatible dimmers switch designated for low voltage loads.
9. LED color temperatures: CRI> 85, 2700K as noted +/- 145K.
10. LED color temperatures: CRI> 85, 4000K as noted +/- 275K.
11. LED color temperatures: CRI> 85, 5000K as noted +/- 283K.
12. Luminaires shall have internal thermal protection.
13. Luminaires shall not draw power in the off state. Luminaires with integral occupancy, motion, photo-controls, or individually addressable luminaires with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.
14. Color spatial uniformity shall be within .004 of CIE 1976 diagram.
15. Color maintenance over rated life shall be within .007 of CIE 1976.
16. Indoor luminaires shall have a minimum CRI of 85.
17. Luminaire manufacturers shall adhere to device manufacturer guidelines, certification programs, and test procedures for thermal management
18. LED package(s)/module(s)/array(s) used in qualified luminaires shall deliver a minimum 70% of initial lumens, when installed in-situ, for a minimum of 50,000 hours.
19. Luminaires shall be fully accessible from below ceiling plane for changing drivers, power supplies and arrays.

B. Power Supplies and Drivers

1. Power Factor: 0.90 or higher
2. Maximum driver case temperature not to exceed driver manufacturer recommended insitu operation.
3. Output operating frequency: 60Hz.
4. Interference: EMI and RFI compliant with FCC 47 CFR Part 15.
5. Total Harmonic Distortion Rating: 20% Maximum.
6. Meet electrical and thermal conditions as described in LM-80 Section 5.0.
7. Primary Current: Confirm primary current with Drawings.
8. Secondary Current: Confirm secondary current specified by individual luminaire manufacturers.
9. Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified control components.
10. Solid-state control components to be integral or external per each specified luminaire. Remote control gear to be enclosed in Class 1, Class 2, or NEMA 3R enclosures as required.

C. Controller and Control System

1. System electronics driver / controller to use coordinated communication protocols: DMX512, 0-10V, DALI, or proprietary as required

SECTION 265100 –  
INTERIOR LIGHTING

2. The Contractor to ensure that external control equipment is compatible with LED control requirements
3. Provide connector types and wiring as appropriate for un-interrupted communication between devices, considering distance maximums, field obstructions, and accessibility. Ensure that connection points are optically isolated for system noise reduction.
4. For control components that are part of overall area control system see Dimming Controls Specifications.
5. Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified power supplies and/or drivers.

2.4 LAMPS

- A. Provide products manufactured by one of the following: Osram/Sylvania, General Electric, Philips, or CCF Facilities Engineering Department approved.
- B. All lamps of the same type are to be provided by the same manufacturer.
- C. Lamp each luminaire with the proper quantity of lamps of the type shown or specified in the Luminaire Schedule
- E. LED
  1. See paragraph LED LUMINAIRES AND DRIVERS of this Section.

2.5 WIRING

- A. All flexible cord wiring between luminaire components or to electrical receptacles and not in wireways shall have a minimum temperature rating of 105 degrees Celsius.
- B. Cords shall be fitted with proper strain reliefs and watertight entries where required by application.
- C. No internal wiring shall be visible at normal viewing angles.

2.6 LUMINAIRE SUPPORT COMPONENTS

- A. Single-Stem Hangers shall be 1/2-inch steel tubing with swivel ball fitting and ceiling canopy. Finish shall be the same as the luminaire.
- B. Twin-Stem Hangers shall be two, 1/2-inch steel tubes with single canopy arranged to mount a single fixture. Finish shall be the same as the luminaire.
- C. Rod Hangers shall be 3/16-inch minimum diameter, cadmium-plated threaded steel rod.
- D. Wires shall be ASTM A 641/A 641M, Class 3, soft temper, zinc coated steel, 12 gauge.
- E. Wires for humid spaces shall be ASTM A 580/A 580M, composition 302 or 304, annealed stainless steel, 12 gauge.
- F. Aircraft Cable Support shall use cable, anchorages, and intermediate supports recommended by luminaire manufacturer.

SECTION 265100 –  
INTERIOR LIGHTING

G. Hangers for pendant industrial luminaires shall be heavy duty No. 8 jack chain with hangers, "S" hooks, mounting straps, and all required accessories for complete installation.

2.7 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with Authorities Having Jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LED, 50,000 hours minimum rated lamp life. Red LED type shall be utilized in areas where red LED types are existing to remain. Green LED type shall be utilized in new construction.

a. Individual LED modules shall not be visible.

2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

a. Battery: Sealed, maintenance-free, nickel-cadmium type.

b. Charger: Fully automatic, solid-state type with sealed transfer relay.

c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

f. Integral Self-Test: Factory-installed electronic device automatically initiates coderequired test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

g. Individual LED modules shall not be visible.

C. Self-Luminous Signs: Using electroluminescent type with universal mounting options, green letters on a clear brushed aluminum finish face.

a. 120/277 VAC 60 Hz operation.

b. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

c. 10 year warranty.

2.18 EMERGENCY LIGHTING UNITS

A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.

2. Charger: Fully automatic, solid-state type with sealed transfer relay.

SECTION 265100 –  
INTERIOR LIGHTING

3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Wire Guard: Heavy-chrome-plated wire guard to protect lamp heads or units in areas where subject to physical damage.
7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
8. Integral Self-Test: Factory-installed electronic device automatically initiates Code required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Luminaires:

1. Set level, plumb, and square with ceilings and walls, and secure according to manufacturers written instructions and approved submittal materials, unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Mounting height indicated from finished floor to bottom of pendant luminaire or to the center of the outlet box for wall mounted luminaires unless otherwise noted. Verify mounting heights with Architect and Lighting Designer.

E. Mounting height may also be indicated as the length of the pendant below finished ceiling.

F. Lay-in Ceiling Luminaire Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices for each luminaire. Locate not more than 6 inches from luminaire corners.

SECTION 265100 –  
INTERIOR LIGHTING

2. Support Clips: Fasten to luminaire and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the application.
  3. Luminaires of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
- G. Suspended Luminaire Support:
1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers.
  3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
  4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
  5. All power feeds shall originate from the same location/end of each run.
  6. Where pendants or rods are longer than 48", brace to limit luminaire swinging.
- H. Provide all necessary hanging or mounting devices and accessories for all luminaires. Verify the types needed for various ceiling conditions. Plaster rings shall be provided where required.
- I. Verify weight and mounting method of all luminaires prior to ordering and provide suitable support. Coordinate with General Contractor for luminaires that require additional blocking or support. Luminaire mounting assemblies shall comply with all local seismic codes and regulations.
- J. Metal decking shall not be pierced for luminaire support.
- K. Refer to architectural reflected ceiling plans for coordination of luminaire locations with mechanical, fire protection, technology and fire safety equipment. Where conflicts occur, coordinate with Architect, Architect/Engineer and Lighting Designer prior to installing any of the Systems.
- L. In accessible suspended ceilings, luminaire wiring connections, including equipment grounding conductor, is to be through use of 72-inch flexible conduit from a rigidly supported junction box.
- M. Wire per requirements of branch circuit installation. Properly ground each luminaire.
- N. Luminaires located in recessed ceilings with a fire resistive rating of 1 hour or more shall be enclosed in an approved fire resistive rated box equal to that of the ceiling. Acoustical ceiling tiles are not acceptable.
- O. Install luminaires with vent holes free of air blocking obstacles.
- P. This Contractor shall be responsible for adjusting aperture flanges or rings on all recessed luminaires to be flush with the finished ceiling. Trim shall completely conceal ceiling opening.
- Q. Brace suspended luminaires installed near ducts or other elements so that they do not swing into obstructions.

SECTION 265100 –  
INTERIOR LIGHTING

R. Wall mounted luminaires shall be supported from four-square outlet box plaster ring and from wall at non-feed end with two 1/4-inch toggle bolts for gypsum board walls or 1/4-inch bolts to pre-set inserts for concrete wall.

S. Luminaires shall not be secured to ductwork or other Systems.

T. Adjust variable position lampholders for proper lamp position prior to luminaire installation.

U. Air-Handling Luminaires: Install with dampers closed and ready for adjustment.

V. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.5 LED LUMINAIRES

A. Adhere to manufacturers installation guidelines regarding proper thermal management.

3.6 LIGHTING CONTROL

A. Provide branch circuiting in coordination with lighting control requirements of Division 26 – and as indicated.

3.7 CLEANING AND ADJUSTING

A. Remove protective plastic covers from luminaires and luminaire diffusers only after construction work, painting and clean-up are completed. Remove, clean, and reinstall all dirty lamps, reflectors and diffusers.

B. Clean luminaires internally and externally after installation. Use methods and materials recommended by manufacturer for cleaning Alzak reflectors and other surfaces.

C. Make final adjustment of aimable luminaires and adjustable light settings under the direction of the Architect and/or Lighting Designer during a scheduled period of time prior to the completion of the Project, after normal business hours if required. Include all equipment and personnel expenses including overtime required for focusing.

D. Luminaires, reflectors, louvers and accessories which are damaged, blemished, or impregnated with fingerprints shall be replaced at this Contractor's expense. All finishes shall be unmarred upon Project completion.

3.8 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

SECTION 265100 –  
INTERIOR LIGHTING

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery/generator and retransfer to normal.
- B. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.
- C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
- D. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- E. Replace all inoperable and burned out lamps at the end of construction prior to Owner occupancy.
- F. Advance Notice: Give dates and times for field tests.
- G. Provide instruments to make and record test results.
- H. Malfunctioning Luminaires and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

END OF SECTION 26 51 00

SECTION 26 56 00 –  
EXTERIOR LIGHTING

SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section provides general requirements for a complete and fully operational Exterior Lighting System including:

1. Exterior Luminaires
2. Accessories
3. Luminaire supports
4. LED Arrays

B. Related Sections:

1. Section 265100 "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.
2. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photosensors, occupancy sensors, and lighting relays and contactors.
3. Section 260519 "Low Voltage Electrical Power Conductors and Cables" for wire and cabling.

1.3 SYSTEM DESCRIPTION

A. Catalog numbers indicated in the Luminaire Schedule are a design series reference and do not necessarily represent the exact catalog number, size, voltage, wattage, type of lamp, ballast, finish trim, ceiling type, mounting hardware or special requirements as Specified or as required by the particular installations. Provide complete luminaire to correspond with the features, accessories, number of lamps, wattage and/or size Specified in the text description of each luminaire type. Additional features, accessories and options Specified shall be included. B. Luminaire voltage shall match the voltage of the circuit serving same.

1.4 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color-rendering index.
- C. LER: Luminaire efficacy rating.

SECTION 26 56 00 –  
EXTERIOR LIGHTING

- D. Luminaire: Complete lighting fixture, including ballast housing if provided.
- E. Pole: Luminaire support structure, including tower used for large area illumination.
- F. Standard: Same definition as "Pole" above.

1.6 SUBMITTALS

- A. The authorized manufacturer's representative for the Project area shall prepare Submittals for each luminaire type. In addition to the luminaire Submittals, a list shall be provided identifying the manufacturer representative for each luminaire type. Provide manufacturers' names, addresses, and telephone numbers. Requests for prior approval shall also include this information. Submittals or requests for prior approval without this information will be rejected.
- B. Product Data shall indicate that luminaire, lamps, ballasts and drivers fully comply with Contract Documents. Data shall be submitted for each type of luminaire indicated, arranged in order of luminaire designation. For standard catalog luminaires provide original product catalog sheets indicating data on features, accessories, finishes, and the following:
  - 1. Materials and dimensions of luminaires.
  - 2. Photometric data, in IESNA format, based on certified results of laboratory tests of each luminaire type, outfitted with lamps, LED arrays, ballasts, drivers and accessories identical to those indicated for the luminaire as applied in the Project.
    - 1. Photometric data shall be certified by a qualified independent testing agency.
    - 3. Low voltage transformers.
    - 4. High intensity discharge ballasts.
    - 5. LED power supplies.
    - 6. Types of lamps and LED's, including manufacturer, wattage, and Color Rendering Index (CRI) and color temperature in degrees Kelvin (K).
- C. Shop Drawings shall:
  - 1. Show details of nonstandard or custom luminaires.
  - 2. Indicate dimensions, weights, method of field assembly, components, features, and accessories.
  - 3. This Contractor shall provide the manufacturer with accurate field dimensions where required.
  - 4. Include wiring diagrams, power and control wiring.
- D. Wiring Diagrams shall detail wiring for luminaires and differentiate between manufacturer installed and field-installed wiring.
- E. Product Certificates shall be signed by manufacturers of luminaires certifying that products comply with requirements.
- F. Maintenance Data shall be provided for luminaires and equipment to include in emergency, operation, and maintenance manuals Specified in Specifications Section describing Operations and Maintenance Data.

SECTION 26 56 00 –  
EXTERIOR LIGHTING

- G. Field quality control test reports.
- H. Special Warranties Specified in this Section.
- I. Review of luminaire submittals which indicate voltage, mounting condition, or quantities shall not be considered to be approval of said voltage, mounting condition, or quantities. This Contractor shall field verify voltage and actual mounting condition and method.
- J. Product samples complete with housing, trim, specified lamp, and 8' cord with plug shall be submitted if requested.
- K. Pole and Support Component Certificates: Signed by Manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a Professional Engineer.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting equipment and luminaires to include in emergency, operation, and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps: 5% of each type and rating installed. Furnish at least one of each type.
  - 2. Glass, Plastic Diffusers and Lenses: 10% or one dozen (whichever is less) of each type and rating installed. Furnish at least one of each type.
  - 3. Globes and Guards: 5% of each type and rating installed. Furnish at least one of each type.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Package poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle with web fabric straps.

1.10 QUALITY ASSURANCE

SECTION 26 56 00 –  
EXTERIOR LIGHTING

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to Authorities Having Jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.
- D. All luminaires shall bear a UL label.
- E. Comply with IEEE C2, “National Electrical Safety Code.”
- F. Designated manufacturers are listed to define the requirements for quality and function of the specified product.

1.11 COORDINATION

- A. Coordinate layout and installation of luminaires with plantings, paving, site walls and other site work elements.
- B. Coordination Meetings: This Contractor shall meet at least twice with the site work installer(s). Hold first meeting before submittal of shop drawings to coordinate each luminaire mounting condition and location. During second meeting, coordinate layout with other site components. Coordinate depth and location of all luminaire pole bases in all areas.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
  - 1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
  - 2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
  - 3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
  - 4. Warranty Period for LED arrays/drivers: Five years from date of Substantial Completion.
  - 5. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.

SECTION 26 56 00 –  
EXTERIOR LIGHTING

6. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to Authorities Having Jurisdiction.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Comply with IESNA TM-15-07 Luminaire Classification System for Outdoor Luminaires.
- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens. G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. Optical assemblies: full cutoff with zero uplight, “dark sky” compliant. LED assemblies shall comply with BUG rating system.
- K. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 90 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.

SECTION 26 56 00 –  
EXTERIOR LIGHTING

- L. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- M. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
  - 2. Finish: premium 5 stage TGIC polyester powder coat paint.
  - 3. Color: See Luminaire Schedule.
- O. Outdoor Wall Mounted Area Luminaires
  - 1. Shall have minimum 52 lumens per watt.
  - 2. No more than 48% of the total luminaire output shall be within the forward 60-80° zone.
  - 3. No more than 3% of the total luminaire output shall be in the forward 80-90° zone.
  - 4. No light at or above horizontal 90-180° zone.
- P. Parking Structure Luminaires
  - 1. Shall have minimum 70 lumens per watt.
  - 2. At least 30% of total luminaire output shall be within the 60-80° zone.
  - 3. No more than 20% of total luminaire output shall be above the 80° zone.
- Q. Canopy Luminaires
  - 1. Shall have minimum 70 lumens per watt.
  - 2. At least 30% of total luminaire output shall be within the 40-60° zone.
  - 3. No more than 20% of total luminaire output shall be above the 80° zone.

2.3 LED DRIVERS AND ARRAYS

- A. UL 1598 listing.
- B. LED arrays shall have LED's that produce minimum 55 lumens/watt when operated at 350mA.
  - 1. Lumen Depreciation Data: At 40 deg C ambient, the L70 hours shall be 50,000 at 520 mA driver.
  - 2. LED color: neutral white, 4100 deg K, CRI of 75. C.

Drivers shall accept 120 through 480 volts, 50/60 Hz.
- D. The housing shall have an integral thermal management system with extruded aluminum radiation fins and lateral airways.

SECTION 26 56 00 –  
EXTERIOR LIGHTING

- E. Comply with IES LM-79-08 and LM-90-08 Approved Methods.
- F. Comply with In-Situ testing for more reliable results.
- G. LED's shall be Restriction of Hazardous Substances Directive (RoHS) compliant.

2.4 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
  - 1. Adjustable window slide for adjusting on-off set points.

2.8 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4-M.
  - 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
  - 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
  - 1. Materials: Shall not cause galvanic action at contact points.
  - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
  - 3. Anchor-Bolt Template: Plywood or steel.
- D. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches with cover secured by stainless-steel captive screws.
- E. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

SECTION 26 56 00 –  
EXTERIOR LIGHTING

2.9 ALUMINUM POLES

- A. Poles: Seamless, extruded structural tube complying with ASTM B 429/B 429M, Alloy 6063T6 with access handhole in pole wall.
  - 1. Shape: Refer to Luminaire Schedule or shall match existing site poles.
  - 2. Mounting Provisions: Butt flange for bolted mounting on foundation.
- B. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- C. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- D. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, and then bolted together with stainless-steel bolts.
  - 1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
  - 2. Finish: Match pole and luminaire material and finish.
- E. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Finish designations prefixed by "AA", comply with the system established by the Aluminum Association for designating aluminum finishes.
  - 2. Finish: Premium five (5) stage TGIC polyester powder coat paint.
    - a. Color: As selected by Architect from manufacturer's full range.

2.10 POLE ACCESSORIES

- A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.
- B. Fusing: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast/driver manufacturer.
- C. Banner Arms: Coordinate with manufacturer for maximum banner size limitations to avoid banner arm or pole failure. Banner arms shall be break-away type to designed to fail before over stressing the pole.
- D. Wind Mitigation Devices: provide in areas of consistent, high, uneven winds.

PART 3 - EXECUTION

SECTION 26 56 00 –  
EXTERIOR LIGHTING

3.1 LUMINAIRE INSTALLATION

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports.
- C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

3.2 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 GROUNDING

- A. Ground metal poles and support structures according to Section 260526 "Grounding and Bonding for Electrical Systems."
  - 1. Install grounding electrode for each pole unless otherwise indicated.
  - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.4 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Replace all burned out or inoperative lamps or LED arrays at the end of Construction prior to Owner occupancy.
- C. Advance Notice: Give dates and times for field tests.
- D. Provide instruments to make and record test results.
- E. Test as follows:
  - 1. Verify proper operation, switching and phasing of each luminaire after installation.
  - 2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation. Verify normal transfer to generator and retransfer to normal.
  - 3. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to the lighting system, retest to demonstrate compliance with standards.

SECTION 26 56 00 –  
EXTERIOR LIGHTING

F. Malfunctioning Luminaires and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

G. Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

H. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):

- a. IESNA LM-64, "Photometric Measurements of Parking Areas."
- b. IESNA LM-72, "Directional Positioning of Photometric Data."

2. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 26 56 00

SECTION 28 31 12 –  
FIRE ALARM SYSTEMS

SECTION 28 31 12 - FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this section.
- B. The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following sections apply:
  - 1. Division 26: "Low Voltage Power Conductors and Cables"
  - 2. Division 26: "Grounding and Bonding for Electrical Systems"
  - 3. Division 21: "Fire Protection".
- C. The system and all associated operations shall be in accordance with the following:
  - 1. Requirements of the following Model Building Code: IBC, Latest Edition
  - 2. Requirements of the following Model Fire Code: NFPA 1, Latest Edition
  - 3. NFPA 72, National Fire Alarm Code, 2016 Edition
  - 4. NFPA 70, National Electrical Code, 2014 Edition
  - 5. NFPA 101, Life Safety Code, 2015 Edition
  - 6. Local Jurisdictional Adopted Codes and Standards
  - 7. ADA Accessibility Guidelines

1.2 SUMMARY

- A. This Section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.
- B. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the drawings and specifications.
- C. The Fire Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:
  - 1. Fire alarm system detection and notification operations.
  - 2. Control and monitoring of fire suppression systems, emergency power systems, and other equipment as indicated in the drawings and specifications.

1.3 SCOPE OF WORK

- A. Design, install, and commission a NFPA72 compliant system fire detection and notification system mixed-use building as defined in bid drawings.

1.4 SYSTEM DESCRIPTION

- A. General: Provide a complete, non-coded addressable, non-proprietary microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.

## B. Power Requirements

1. The control unit shall receive AC power via a dedicated circuit.
2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 90 hours with 15 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.
3. All circuits requiring system-operating power shall be 24 VDC nominal voltage and shall be individually fused at the control unit.
4. The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit. A green "power on" LED shall be displayed continuously at the user interface while incoming power is present.
5. The system batteries shall be supervised so that a low battery or a depleted battery condition, or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.
6. The system shall support NAC Lockout feature to prevent subsequent activation of Notification Appliance Circuits after a Depleted Battery condition occurs in order to make use of battery reserve for front panel annunciation and control.
7. The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.
8. Loss of primary power shall sound a trouble signal at the FACU. FACU shall indicate when the system is operating on an alternate power supply.

## C. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary.

1. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation.
2. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory.
3. Panels shall be capable of full system operation during new site specific configuration download, master exec downloads, and slave exec downloads.
4. Remote panel site-specific software and executive firmware downloads shall be capable of being performed over proprietary fire alarm network communications, and via TCP/IP Ethernet network communications. Ethernet access to any fire alarm panel shall be capable of providing access only to authenticated users through a cryptographically authenticated and secure SSL tunnel.
5. Panels shall automatically store all program changes to the panel's non-volatile

memory each time a new program is downloaded. Panels shall be capable of storing the active site-specific configuration program and no less than 9 previous revisions in reserve. A compare utility program shall also be available to authorized users to compare any two of the saved programs. The compare utility shall provide a deviation report highlighting the changes between the two compared programs.

6. Panels shall provide electronic file storage with a means to retrieve a record copy of the site-specific software and up to 9 previous revisions. Sufficient file storage shall be provided for other related system documentation such as record drawings, record of completion, owner's manuals, testing and maintenance records, etc.

7. The media used to store the record copy of site-specific software and other related system documentation shall be electrically supervised. If the media is removed a trouble shall be reported on the fire alarm control unit.

D. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.

E. Recording of Events: The system shall be capable of recording all alarm, supervisory, and trouble events by means of system printer. The printout shall include the type of signal (alarm, supervisory, or trouble) the device identification, date and time of the occurrence. The printout shall differentiate alarm signals from all other printed indications.

F. Wiring/Signal Transmission:

1. Transmission shall be hard-wired using separate individual circuits for each zone of alarm operation, as required or addressable signal transmission, dedicated to fire alarm service only.

2. System connections for initiating device circuits shall be Class B, Style D, signaling line circuits shall be Class B, Style 4 and notification appliance circuits shall be Class B, Style Y.

3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACU. Provide a distinctive indicating audible tone and alphanumeric annunciation.

G. Supplemental Notification and Remote User Access (Fire Panel Internet Interface)

1. Fire Alarm Control Unit (FACU) shall have the capability to provide supplemental notification and remote user access to the FACU using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3.

2. A standard RJ-45 Ethernet connection shall connect to the owner's Ethernet network. Provisions for that connection must be provided at each fire alarm control unit as part of the contract.

3. The means of providing supplemental email and SMS text messaging notification shall be agency listed for specific interfaces and for the purpose described in this section. The use of non-listed external third party products and interfaces is not acceptable.
4. The fire panel internet interface shall be capable of sending automated notification of discrete system events via email and SMS text messaging to up to 50 individual user accounts and via email to up to 5 distribution lists.
5. Each user account and distribution list shall be capable of being configurable for the specific type of events to be received. Each account shall be configurable to receive notification upon any combination of the following types of events:
  - a) Fire Alarm,
  - b) Priority 2,
  - c) Supervisory,
  - d) Trouble,
  - e) Custom Action Messages,
  - f) Fire Panel Internet Interface Security Violations
6. Each user account and distribution list shall be capable of being configurable for the specific content to be received. Each account shall be configurable to receive any combination of the following message content:
  - a) Summary,
  - b) Event Information,
  - c) Message,
  - d) Emergency Contacts,
  - e) Host Fire Alarm Control Unit Information
7. Each user account and distribution list shall be capable of being configurable for the type of Fire Alarm Control Unit Logs and Reports to be received. Each account shall be configurable to receive any combination of the following Logs and Reports via email:
  - a) Alarm Log,
  - b) Trouble Log,
  - c) Analog Sensor Status Report,
  - d) Analog Sensor Service Report,
  - e) Almost Dirty, Dirty and Excessively Dirty Sensor Report,
  - f) CO Analog Sensor Service Report,
  - g) Addressable Notification Appliance Candela Report,
  - h) Addressable Notification Appliance Status Report
8. Each user account and distribution list shall be capable of receiving email distribution of Fire Alarm Control Unit Logs and Reports On-Demand or automatically on a Pre-Determined schedule. Receipt of Logs and Reports shall be capable of being scheduled as follows:
  - a) Weekly, or
  - b) Bi-weekly, or
  - c) Monthly
9. The Fire Alarm Control Unit Logs and Reports shall be sent in CSV file format which can be imported into common database applications for viewing, sorting,

and customization.

- a) Each user account shall be capable of being configured to receive system events via email and/or SMS text messaging.
  - b) Each distribution list shall be capable of supporting up to 20 email address recipients.
10. The means to provide email notification shall be compatible with SMTP mail servers, ISP email services, and Internet email services. Communication with the email server shall be verified at selectable intervals of 5 to 30 minutes.
11. Email operation shall be capable of being disabled for service by the system administrator.
12. An email log shall be accessible to authorized users. The email log shall display the 25 most recent email notifications sent.
13. The fire panel internet interface for supplemental notification and remote user access shall support:
- a) Secure HTTPS/SSL encrypted connections,
  - b) Up to 50 individual password protected user accounts,
  - c) Dynamic and Static IP addressing,
  - d) IP Address Blocking,
  - e) Restricted number of log-in attempts before lock-out configurable from 1 to 20,
  - f) Lock-out duration after unsuccessful log-in attempts configurable from 0 to 24 hours,
  - g) Email notification to Administrators of unsuccessful log-in attempts,
  - h) Automatic lock-out reset upon a new event,
  - i) Automatic inactivity logout configurable from 10 minutes to 24 hours,
  - j) Firmware updates over Ethernet,
  - k) Set-up and configuration via Local Service Port or via Remote Services over LAN/WAN connection
14. Authorized users shall be capable of accessing the fire alarm panel using a compatible web browser (Internet Explorer 6.0 or higher) and a secure HTTPS/SSL encrypted connection.
15. The fire panel internet interface shall support concurrent connections for up to 5 users plus 1 administrator.
16. Authorized users with remote access shall be capable of:
- a) Viewing the fire panel internet interface web home page
    - (a) The fire panel internet interface home page shall display system status information and provide links to detailed status information and fire alarm panel reports and history logs
    - (b) The web browser on the user's computer shall automatically refresh system status information upon a new event
      - (1) Systems that require a manual refresh to acquire updated system status information shall not be accepted
  - b) Viewing the fire alarm panel detailed card status information
  - c) Viewing the fire alarm panel detailed point status information

- d) Viewing the fire alarm panel reports and history logs
- e) Viewing the fire panel internet interface email log
- f) Viewing system summary information
- g) Accessing Custom Hypertext Links

17. The fire panel internet interface home page shall support customization to display the following information:

- a) Customer Name and Address,
- b) Fire Panel Location or Building Name,
- c) Up to 10 Custom Hypertext Links with Text Descriptions

#### H. Remote Services Access:

1. Fire Alarm Control Unit (FACU) shall have the capability to provide a remote service access feature using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3. The Remote Access feature shall provide automatic notification of system faults and remote diagnostics of system status for responding technicians prior to arrival on site.
2. A standard RJ-45 Ethernet connection shall connect to the owner's Ethernet network. Provisions for that connection must be provided at each fire alarm control unit as part of the contract.
3. The Ethernet access feature shall be agency listed for specific interfaces and for the purpose described in this section. The use of non-listed external third party interfaces is not acceptable.
4. The internet remote access service function shall provide automated real time off-site reporting of discrete system events to a remote service support center with details of internal FACU fault conditions allowing a pre-site visit analysis of repair requirements.
5. Existing FACU controls shall be capable of retrofitting the Remote Service module as a plug-in upgrade feature.
6. The remote service network shall work on the customers Ethernet infrastructure and be Fire-Wall friendly for two-way communications for off-site reporting. The feature shall be compatible with existing proxy servers and firewalls shall not require any special changes or modifications.
7. The remote service system shall be able to connect to the remote service center without the need for a VPN account or similar tunnel.
8. The remote service system shall be a non Windows based application to protect against conventional virus attacks.
9. The remote service system shall support a secure connection with strong encryption, 128 bit or better, and an optional secondary encryption method if required.
10. The remote service system shall be compatible with virtual LANS (VLAN).

11. The remote service system shall work on an outbound communication premise in order to eliminate the possibility of any inbound connection into the network.
  12. The remote service system shall provide an audit trail of all events and service connections.
  13. The Remote Service connection will provide access for panel software downloads and uploads for archiving job specific programs back at the enterprise server.
  14. The supplier shall provide an option for a service contract for the Remote Service program that provides the following requirements:
    - a) 24/7 recording of FACU service activity.
    - b) Off-site diagnostics by a technical specialist to provide repair and parts guidance to the service technician prior to a site visit.
- I. Required Functions: The following are required system functions and operating features:

1. Priority of Signals: Fire alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second-, third-, and fourth-level priority, respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.
2. Noninterfering: An event on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACU after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent addressable device activations.
3. Transmission to an approved Supervising Station: Automatically route alarm, supervisory, and trouble signals to an approved supervising station service provider, under another contract.
4. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACU and the remote annunciator, indicating the type of device, the operational state of the device (i.e. alarm, trouble or supervisory) and shall display the custom label associated with the device.
5. Selective Alarm: A system alarm shall include:
  - a) Indication of alarm condition at the FACU and the annunciator(s).
  - b) Identification of the device /zone that is the source of the alarm at the FACU and the annunciator(s).
  - c) Operation of audible and visible notification appliances until silenced at FACU.
  - d) Closing doors normally held open by magnetic door holders.
  - e) Unlocking designated doors.
  - f) Shutting down supply and return fans serving zone where alarm is initiated.
  - g) Closing smoke dampers on system serving zone where alarm is initiated.

- h) Initiation of smoke control sequence.
  - i) Transmission of signal to the supervising station.
  - j) Initiation of elevator Phase I functions (recall, shunt trip, illumination of indicator in cab, etc.) in accordance with ANSI/ASME A17.1 / CSA B44, Safety Code for Elevators and Escalators, when specified detectors or sensors are activated, as appropriate.
6. Supervisory Operations: Upon activation of a supervisory device such as a tamper switch, the system shall operate as follows:
- a) Activate the system supervisory service audible signal and illuminate the LED at the control unit and the remote annunciator.
  - b) Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.
  - c) Record the event in the FACU historical log.
  - d) Transmission of supervisory signal to the supervising station.
  - e) Restoring the condition shall cause the Supervisory LED to clear and restore the system to normal.
7. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible and visible alarm signals shall cease operation.
8. Priority Two Operations: Upon activation of a priority two condition , the system shall operate as follows:
- a) Activate the system priority two audible signal and illuminate the LED at the control unit and the remote annunciator.
  - b) Pressing the Priority 2 Acknowledge Key will silence the audible signal while maintaining the Priority 2 LED "on" indicating off-normal condition.
  - c) Record the event in the FACU historical log.
  - d) Transmission of priority two signal to the supervising station.
  - e) Restoring the condition shall cause the Priority 2 LED to clear and restore the system to normal.
9. System Reset
- a) The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-alarmed the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."
  - b) Should an alarm condition continue, the system will remain in an alarmed state.
10. A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.
11. WALKTEST: The system shall have the capacity of 8 programmable passcode protected one person testing groups, such that only a portion of the system need be disabled during testing. The actuation of the "enable one person test" program at the control unit shall activate the "One Person Testing" mode of the system as

follows:

- a) The city circuit connection and any suppression release circuits shall be bypassed for the testing group.
  - b) Control relay functions associated with one of the 8 testing groups shall be bypassed.
  - c) The control unit shall indicate a trouble condition.
  - d) The alarm activation of any initiating device in the testing group shall cause the audible notification appliances assigned only to that group to sound a code to identify the device or zone.
  - e) The unit shall automatically reset itself after signaling is complete.
  - f) Any opening of an initiating device or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.
12. Install Mode: The system shall provide the capability to group all non-commissioned points and devices into a single "Install Mode" trouble condition allowing an operator to clearly identify event activations from commissioned points and devices in occupied areas.
- a) It shall be possible to individually remove points from Install Mode as required for phased system commissioning.
  - b) It shall be possible to retrieve an Install Mode report listing that includes a list of all points assigned to the Install Mode. Panels not having an install mode shall be reprogrammed to remove any non-commissioned points and devices.
13. Module Distribution:
- a) The fire alarm control unit shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 4 (Class B) supervised serial communications channel (SLC):
    - (a) Initiating Device Circuits
    - (b) Notification Appliance Circuits
    - (c) Auxiliary Control Circuits
    - (d) Graphic Annunciator LED/Switch Control Modules
      - (1) In systems with two or more Annunciators and/or Command Centers, each Annunciator/Command Center shall be programmable to allow multiple Annunciators/Command Centers to have equal operation priority or to allow hierarchal priority control to be assigned to individual Annunciator/Command Center locations.
    - (e) Initiating Device Signaling Line Circuits
    - (f) Notification Appliance Signaling Line Circuits
    - (g) Power Supplies
14. Service Gateway: A Service Gateway software application shall be provided that allows an authorized service person to remotely query panel status during testing, commissioning, and service without the need to return to the panel using standard email or instant messaging tools. For systems without a service gateway application the service provider shall provide a minimum of two technicians for any system testing or commissioning.

## J. Integrated Automation

### 1. Security Integration

- a) The FA System shall provide the means to be integrated directly to OEM Security Management System (SMS) via a software interface for the purpose of communicating fire alarm events directly to the security system.
- b) Communication between the FA System and SMS shall be accomplished using Computer Port Protocol (CPP).
  - (a) The FA and the SMS shall be connected via a local or network serial port server based RS-232 serial port connection.
- c) The CPP shall consist of a bi-directional serial protocol capable of accessing most of the Fire Alarm Control Unit (FACU) diagnostic features.
- d) The interface shall provide the means to communicate the following information to the SMS:
  - (a) Device/Point status changes (e.g., Fire, Trouble, Disabled)
  - (b) Panel event status (e.g. Number of Unacknowledged Fire Alarms, Card Failure Troubles, etc.)
  - (c) Panel health status (e.g., AC power, battery status)
- e) Interface software shall include a data acquisition function that provides the following:
  - (a) Establishes and maintains a supervised serial link
  - (b) Extraction of the point database from the FACU
  - (c) Merges the FACU database into the SMS database
- f) The software interface shall not allow system control functionality from the SMS to the FA System.
- g) The installation, programming and maintenance of the FA/SMS integration software interface shall be conducted by factory trained certified technicians.

2. Building Automation and Control Network (BACnet) Integration

- a) The fire alarm control unit shall be capable of providing a one-way communications interface between the fire alarm control unit and an industry-standard Building Automation and Control Network (BACnet).
- b) The BACnet communications module shall be agency listed to UL Standard 864 ULC Standard S527.
- c) The fire alarm control unit shall be capable of communicating minimum 256 status changes to the building automation system.
- d) A standard RJ-45 Ethernet connection to the Building Automation System Ethernet network shall be provided at the fire alarm control unit as part of the contract.

K. Analog Smoke Sensors:

- 1. Monitoring: FACU shall individually monitor sensors for calibration, sensitivity, and alarm condition, and shall individually adjust for sensitivity. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values.
- 2. Environmental Compensation: The FACU shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.
- 3. Programmable Sensitivity: Photoelectric Smoke Sensors shall have 7 selectable sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACU.

4. Sensitivity Testing Reports: The FACU shall provide sensor reports that meet NFPA 72 calibrated test method requirements.
  - a) Reports shall be capable of being printed for annual recording and logging of the calibration maintenance schedule.
  - b) Where required, reports shall be accessible remotely through:
    - (a) A Fire Panel Internet Interface using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3. The Fire Panel Internet Interface shall be capable of automatically scheduling email reports to individual user accounts on a weekly, bi-weekly, or monthly schedule
    - (b) A PC Annunciator using an RS232-C connection to the FACU or a PC Annunciator Client using a TCP/IP communications protocol connection to the PC Annunciator server compatible with IEEE Standard 802.3.
5. The FACU shall automatically indicate when an individual sensor needs cleaning. The system shall provide a means to automatically indicate when a sensor requires cleaning. When a sensor's average value reaches a predetermined value, (3) progressive levels of reporting are provided. The first level shall indicate if a sensor is close to a trouble reporting condition and will be indicated on the FACU as "ALMOST DIRTY." This condition provides a means to alert maintenance staff of a sensor approaching dirty without creating a trouble in the system. If this indicator is ignored and the second level is reached, a "DIRTY SENSOR" condition shall be indicated at the FACU and subsequently a system trouble is reported to the Supervising Station. The sensor base LED shall glow steady giving a visible indication at the sensor location. The "DIRTY SENSOR" condition shall not affect the sensitivity level required to alarm the sensor. If a "DIRTY SENSOR" is left unattended, and its average value increases to a third predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control unit.
6. The FACU shall continuously perform an automatic self-test on each sensor that will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition.
7. Multi-Sensors shall combine photoelectric smoke sensing and heat sensing technologies. An alarm shall be determined by either smoke detection, with selectable sensitivity from nominal 0.2 to 3.7 %/ft obscuration; or heat detection, selectable as fixed temperature or fixed with selectable rate-of-rise; or based on an analysis of the combination of smoke and heat activity.
8. Programmable bases. It shall be possible to program relay and sounder bases to operate independently of their associated sensor.
9. Magnet test activation of smoke sensors shall be distinguished by its label and history log entry as being activated by a magnet.

L. Fire Suppression Monitoring:

1. Water flow: Activation of a water flow switch shall initiate general alarm operations.

2. Sprinkler valve tamper switch: The activation of any valve tamper switch shall activate system supervisory operations.
3. Water flow switch and sprinkler valve tamper switch shall be capable of existing on the same initiating zone. Activation of either device shall distinctly report which device is in alarm on the initiating zone.

M. Audible Alarm Notification: By horns in areas as indicated on drawings.

N. Addressable Notification Appliances (Applies only where addressable notification is provided):

1. Monitoring: The FACU shall monitor individual addressable notification appliances for status, condition, type of appliance, and configured appliance settings. A fault in any individual appliance shall automatically report a trouble condition on the FACU.
2. Individual Appliance Custom Label: Each addressable appliance shall have its own 40 character custom label to identify the location of the appliance and to aid in troubleshooting fault conditions.
3. Individual Appliance Information Display:
  - a) The FACU shall be capable of calling up detailed information for each addressable appliance including the appliance location, status, condition, type of appliance, and configured appliance settings.
  - b) Notification appliances that are not capable of communicating and reporting their individual location, status, condition, type of appliance, and configured appliance settings to the FACU shall not be accepted.
4. Programmable Appliance Settings:
  - a) The selectable operation of each addressable notification appliance shall be capable of being configured by the FACU without having to replace or remove the appliance from the wall or ceiling.
    - (a) Programmable appliance settings for applicable addressable notification appliances shall include:
      - (1) Operation:
        - ((a)) General Evac
        - ((b)) Alert
        - ((c)) User Defined
      - (2) Style:
        - ((a)) Indoor
        - ((b)) UL Weatherproof
        - ((c)) ULC Weatherproof
      - (3) Candela Selections:
        - ((a)) Indoor: 15, 30, 75, 110, 135, or 185 cd (per UL1971)
        - ((b)) UL Weatherproof: 15 or 75 cd (per UL1971), and 75 or 185 cd (per UL1638)
        - ((c)) ULC Weatherproof: 20, 30 or 75 cd (per ULCS526)
      - (4) Horn Volume:
        - ((a)) Hi
        - ((b)) Low

- (5) Horn Cadence:
  - ((a)) Temporal 3
  - ((b)) Temporal 4
  - ((c)) March Time 20 bpm
  - ((d)) March Time 60 bpm
  - ((e)) March Time 120 bpm
  - ((f)) Steady
- (6) Horn Tone:
  - ((a)) 520 HZ
  - ((b)) Bell
  - ((c)) Slow Whoop
  - ((d)) Siren
  - ((e)) Hi / Lo

5. Programmable Notification Zones:

- a) Changing the notification zone assigned to a notification appliance shall be configurable by the FACU and shall not require additional circuits or wiring.
- b) Systems that require additional circuits and wiring to change the notification zone assigned to a notification appliance shall not be accepted.

6. Other Emergency and Non Emergency Notification:

- a) Where required, notification appliances for purposes not related to fire alarm shall be capable of:
  - (a) being connected to the same circuit as the fire alarm appliances, and
  - (b) being individually configured for their intended use without requiring additional circuits or wiring.
- b) Systems that require separate circuits and wiring for other Emergency and Non Emergency notification shall not be accepted.

7. Addressable Notification Appliance Automated Self-Test:

- a) The fire alarm control unit shall be capable of performing an automated functional self-test of all self-test notification appliances and meet the requirements in NFPA 72, 2013 Edition, 14.2.8 Automated Testing and Table 14.4.3.2 testing requirements.
- b) Test results for each self-test notification appliance shall be stored in non-volatile memory at the fire alarm control unit.
- c) The fire alarm control unit shall be capable of running a functional automated test for all self-test notification appliances in a general alarm group or for all self-test appliances within a specific notification zone.
- d) The duration required to complete the automated functional test for all self-test notification appliances shall be accomplished in 2 minutes or less.
- e) The automated test results for all self-test notification appliances shall be available from the fire alarm control unit within 4 minutes from the start of the test.
- f) If any notification appliance fails its automated functional self-test an audible and visual trouble signal shall be annunciated at the fire alarm control unit.
  - (a) The self-test trouble signal shall be a latching trouble signal which requires manual restoration to normal.

8. Addressable Notification Appliance Reports:

- a) The fire alarm control unit shall maintain configuration and test data for each self-test addressable notification appliance.
  - b) The fire alarm control unit shall be capable of generating configuration, self-test, and deficiency reports, that can be viewed through the fire alarm control unit user interface or printed via the fire alarm control unit service port.
    - (a) At minimum, the configuration report shall include the following information applicable for each addressable notification appliance:
      - (1) Point ID
      - (2) Custom Label
      - (3) Device Type
      - (4) Candela Setting
    - (b) At minimum, the self-test report shall include the following information applicable for each self-test notification appliance:
      - (1) Point ID
      - (2) Custom Label
      - (3) Time and Date of last test
      - (4) Pass / Fail results of last visual test
      - (5) Pass / Fail results of last audible test
  - c) The fire alarm control unit shall also be capable of providing a deficiency report that includes a list of all self-test notification appliances that have failed self-test.
9. Magnet test: When the control unit is in diagnostic mode, the appliances shall be capable of being tested with a magnet. The magnet diagnostics shall:
- a) Pulse the appliance LED to indicate appliance address.
  - b) briefly flash the individual strobe to confirm visible appliance operation.

## 1.5 SUBMITTALS

### A. General: Submit the following according to Conditions of Contract.

1. Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.
2. Wiring diagrams from manufacturer.
3. Shop drawings showing system details including location of FACU, all devices, circuiting and details of graphic annunciator.
4. System power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate in accordance with the prescribed backup time periods and under all voltage conditions per UL and NFPA standards.
5. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, SLC, NAC, relay, sensor, and auxiliary control circuits.

6. Operating instructions for FACU.
  7. Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.
  8. Product certification signed by a certified representative of the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.
  9. Record of field tests of system.
- B. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of shop drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, make resubmissions, if required, to make clarifications or revisions to obtain approval.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A factory authorized installer is to perform the work of this section.
- B. Each and every item of the Fire Alarm System shall be listed under the appropriate category by a Nationally Recognized Testing Laboratory and shall bear the respective "NRTL" label.

#### 1.7 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
  1. Notify Architect no fewer than two days in advance of proposed interruption of fire-alarm service.
  2. Do not proceed with interruption of fire-alarm service without Architect's written permission.

#### 1.8 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

## 1.9 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
  - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

## 1.10 MAINTENANCE SERVICE (OPTIONAL)

- A. Warranty Maintenance Service: Provide maintenance of fire alarm systems and equipment for a period of 12 months, using factory-authorized service representatives
- B. Basic Services: Routine maintenance visits on an "as needed" basis at times scheduled with the Owner. Respond to service calls within 24 hours of notification of system trouble either by customer visit or other customer contact as necessary. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.
- C. Additional Services: Perform services within the above 12-month period not classified as routine maintenance or as warranty work when authorized in writing. Compensation for additional services must be agreed upon in writing prior to performing services.
- D. Maintenance Service Contract: No later than 60 days prior to the expiration of the warranty maintenance services, deliver to the Owner a proposal to provide contract maintenance and repair services for an additional one-year term. As an option with this proposal, deliver to the Owner a proposal to provide scheduled inspection and testing services for a one-year term. Owner will be under no obligation to accept maintenance service contract proposal or inspection and testing proposal.

## 1.11 EXTRA MATERIALS

- A. General: Furnish extra materials, packaged with protective covering for storage, and identified with labels clearly describing contents as follows:
  - 1. Break Rods for Manual Stations: Furnish quantity equal to 15 percent of the number of manual stations installed; minimum of 6 rods.
  - 2. Notification Appliances: Furnish quantity equal to 10 percent of each type and number of units installed, but not less than one of each type.
  - 3. Smoke Detectors or Sensors, Fire Detectors, and Flame Detectors: Furnish quantity equal to 10 percent of each type and number of units installed but not

less than one of each type.

4. Detector or Sensor Bases: Furnish quantity equal to 2 percent of each type and number of units installed but not less than one of each type.
5. Printer Ribbons: Furnish 6 spare printer ribbons when a printer is provided.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE EQUIPMENT AND SERVICE PROVIDERS

- A. Manufacturers: The equipment and service described in this specification are those supplied in compliance with all UL life safety requirements and supported by service centers with NICET certified technicians.
- B. Being an acceptable Manufacturer in no way relieves obligation to provide all equipment and features in accordance with these specifications.
- C. Alternate products must be submitted to the Owner at the time of bid for approval. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.
- D. The equipment and service provider shall be a nationally recognized company specializing in fire alarm and detection systems. This provider shall employ factory trained and NICET certified technicians, and shall maintain a service organization within 100 miles of this project location. The equipment and service provider shall have a minimum of 5 years experience in the fire protective signaling systems industry.

### 2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
  1. Manual stations.
  2. Heat detectors.
  3. Flame detectors.
  4. Smoke detectors.
  5. Duct smoke detectors.
  6. Verified automatic alarm operation of smoke detectors.
  7. Automatic sprinkler system water flow.
  8. Heat detectors in elevator shaft and pit.
  9. Fire-extinguishing system operation.

- B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances.
  2. Identify alarm at fire-alarm control unit and remote annunciators.
  3. Transmit an alarm signal to the remote alarm receiving station.
  4. Unlock electric door locks in designated egress paths.
  5. Release fire and smoke doors held open by magnetic door holders.
  6. Activate emergency lighting control.
  7. Activate emergency shutoffs for gas and fuel supplies.
  8. Record events in the system memory.
  9. Record events by the system printer.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
  2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
  3. Loss of primary power at fire-alarm control unit.
  4. Ground or a single break in fire-alarm control unit internal circuits.
  5. Abnormal AC voltage at fire-alarm control unit.
  6. Break in standby battery circuitry.
  7. Failure of battery charging.
  8. Abnormal position of any switch at fire-alarm control unit or annunciator.
  9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
- E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer where provided.

## 2.3 FIRE ALARM CONTROL UNIT (FACU)

- A. General: Comply with UL 864, "Control Units and Accessories for Fire Alarm Systems".
- B. The following FACU hardware shall be provided:
  - 1. Power Limited base panel with red cabinet and door, 120 VAC input power.
  - 2. Minimum 256 point capacity where (1) point equals (1) monitor (input) or (1) control (output).
  - 3. Minimum 256 point of annunciation where one (1) point of annunciation equals:
    - a) 1 LED driver output on a graphic driver or 1 switch input on a graphic switch input module.
    - b) 1 LED on panel or 1 switch on panel.
  - 4. 9 Amp Power Supply minimum with temperature compensated, dual-rate battery charger capable of charging up to 110 Ah batteries without a separate external battery charger. Battery charger voltage and amperage values shall be accessible on the FACU LCD display.
  - 5. One Auxiliary electronically resettable fused 2A @24VDC Output, with programmable disconnect operation for 4-wire detector reset.
  - 6. One Auxiliary Relay, SPDT 2A @32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.
  - 7. Three (3) Class B Addressable Notification Appliance Signaling Line Circuits (SLCs).
    - a) Each Addressable Notification Appliance SLC shall be rated at 3A and capable of supporting up to 127 Notification Appliances per channel.
    - b) Wiring shall be 18 AWG to 12 AWG unshielded twisted pair wire. Systems that require shielded wire for Notification Appliances shall not be accepted.
    - c) A constant voltage under both primary and secondary power conditions shall be maintained at the notification appliance field wiring terminal connections in the FACU to ensure the voltage drop on the circuit is consistent under both primary and secondary power conditions.
    - d) For systems that do not provide a constant voltage source at the FACU notification appliance field wiring terminal connections, the fire alarm contractor shall:
      - (a) Provide separate point-to-point voltage drop calculations for all notification appliances under worst case secondary power specifications, and
      - (b) Perform a complete functional test of all notification appliances under worst case secondary power conditions.
  - 8. Three (3) Class B Notification Appliance Circuits (NAC; rated 3A@24VDC, resistive).
    - a) NAC's shall be conventional reverse polarity operation and shall be for synchronized strobes and independent horn/strobe operation over two wires.

- b) NACs shall be selectable as auxiliary power outputs derated to 2 A for continuous duty.
  - c) Strobe synchronization and audible cadence synchronization shall be across all panel NAC circuits. Systems that cannot provide listed synchronization across all panel NAC's shall not be acceptable.
9. Where required provide Intelligent Remote Battery Charger for charging up to 50Ah batteries.
  10. Expansion Power Supplies with three (3) Class B integral Intelligent Addressable Notification Appliance Signaling Line Circuits (SLCs) for system expansion. Expansion power supplies shall provide complete capability as the primary power supply.
  11. Power Supplies with integral conventional reverse polarity Notification Appliance Circuit Class B for system expansion. Expansion power supplies shall provide complete capability as the primary power supply.
  12. Four (4) form "C" Auxiliary Relay Circuits (Form C contacts rated 2A @ 24VDC, resistive), operation is programmable for trouble, alarm, supervisory or other fire response functions. Relays shall be capable of switching up to ½ A @ 120VAC, inductive.
  13. The FACU shall support up to (5) RS-232-C ports and one service port. All (5) RS-232 Ports shall be capable of two-way communications.
  14. Remote Unit Interface: supervised serial communication channel for control and monitoring of remotely located annunciators and I/O panels.
  15. Municipal City Circuit Connection with Disconnect switch, 24VDC Remote Station (reverse polarity), local energy, shunt master box, or a form "C" contact output.
  16. Programmable DACT for either Common Event Reporting or per Point Reporting.
  17. Fire Panel Internet Interface to provide supplemental notification and remote user access to the FACU using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3.
- C. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.
- D. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.
1. The system shall have the capability to provide expanded content, multi-line, operator interface displays. The expanded content multi-line displays shall be Quarter-VGA (QVGA) or larger and be capable of supporting a minimum of 854

standard ASCII characters to minimize or eliminate the levels of navigation required for access to information when responding to critical emergencies and abnormal system conditions. The QVGA operator interface shall provide operator prompts and six context sensitive soft-keys for intuitive operation.

- a) Expanded content, multi-line operator interfaces shall be capable of providing the following functions:
  - (a) Dual language operation with Instant-Switch language selection during runtime.
  - (b) Activity display choices for:
    - (1) First 8 Events.
    - (2) First 5 Events and Most Recent Event (with first and most recent event time and date stamps).
    - (3) First Event and Most Recent Event (with first and most recent event time and date stamps).
    - (4) Scrollable List Display displays a scrollable list of active points for the event category (alarm, priority 2, supervisory, or trouble) selected. The position in this list will be the last acknowledged point (not flashing) at the top followed by the next 7 unacknowledged points (flashing).
    - (5) General Event Status (alarm, priority 2, supervisory, or trouble in system)
    - (6) Site Plan
  - (c) Equal or hierarchal priority assignment. In systems with two or more operator interfaces, each operator interface shall be programmable to allow multiple operator interfaces to have equal operation priority or to allow hierarchal priority control to be assigned to individual operator interfaces (locations).
  - (d) Up to 50 custom point detail messages for providing additional point specific information in detailed point status screens.
  - (e) Bitmap file import for operator interface display of site plan and background watermark images.
- b) Expanded content, multi-line displays shall have the capability to provide
  - (a) Language selection shall be via a switch on the operator interface panel. Operator interface panels shall support instant-language-switchover during runtime to allow the operator to toggle between languages each time the language selection switch is operated, without requiring complicated multi-step processes.
  - (b) Both one-byte and two-byte characters shall be supported.

E. Distributed Module Operation: FACU shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 4 (Class B) supervised serial communications channel (SLC):

1. Addressable Signaling Line Circuits
2. Initiating Device Circuits
3. Notification Appliance Circuits
4. Auxiliary Control Circuits

## 5. Graphic Annunciator LED/Switch Control Modules

- a) In systems with two or more Annunciators and/or Command Centers, each Annunciator/Command Center shall be programmable to allow multiple Annunciators/Command Centers to have equal operation priority or to allow hierarchal priority control to be assigned to individual Annunciator/Command Center locations.

## 2.4 ADDRESSABLE INITIATING

### A. ADDRESSABLE MANUAL PULL STATIONS

1. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
2. Description: Addressable double- action type, red LEXAN. Station shall mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units. Station shall be pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit. Where double-action stations are provided, the mechanism shall require two actions push top activation door to initiate an alarm.
3. Provide with a front showing red LED showing that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the station LED shall be on steady.
4. Indoor Protective Shield: Where required, or as indicated on the drawings, provide a factory-fabricated, tamperproof, clear LEXAN enclosure shield and red frame that easily fits over manual pull stations which shall be hinged at the top to permit lifting for access to initiate a local alarm. Unit shall be NRTL listed. Lifting the cover shall actuate an integral battery-powered audible horn intended to discourage false-alarm operation. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.
5. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

### B. ADDRESSABLE ANALOG SMOKE SENSORS

1. General Requirements for System Smoke Detectors:
  - a) Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:
  - b) Factory Nameplate: Serial number and type identification.
  - c) Operating Voltage: 24 VDC, nominal and shall be two-wire type.
  - d) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
  - e) Plug-In Arrangement: Sensor and associated electronic components are

mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. Provide terminals in the fixed base for connection to building wiring. No special tools shall be required to remove head once it has been locked. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit. Sensors shall include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACU. Sensor address shall be located in base to eliminate false addressing when replacing sensors. Integral Addressable Module shall be arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit. Each sensor base shall contain an integral visual-indicating LED.

- f) Each sensor base shall contain a magnetically actuated test switch to provide for easy pre-certification alarm testing at the sensor location.
- g) Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.
- h) Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit. Provide multiple levels of detection sensitivity for each sensor.
- i) Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACU.
- j) The sensor's electronics shall be immune from nuisance alarms caused by EMI and RFI. Removal of the sensor head for cleaning shall not require the setting of addresses.
- k) Bases: CO Sensor, relay output, sounder and isolator bases shall be supported alternatives to the standard base.

## 2. Addressable Sensor Bases

- a) Standard base - Twist lock addressable base with address selection DIP switch accessible from front with sensor removed. Integral red LED for power-on (pulsing), or alarm or trouble (steady on). Locking anti-tamper design mounts on standard outlet box.
- b) Sensor Base with remote device connection - All standard base features with wired connection for either a Remote LED alarm indicator or remote relay (relay is unsupervised and requires separate 24VDC)
- c) Supervised Relay Bases - All standard base features and shall be available in either a 4-Wire Sensor Base to use with remote or locally mounted relay; requires separate 24 VDC, or as a 2-Wire Sensor Base to use with remote or locally mounted relay; no separate power required. Supervised relay operation shall be programmable and shall be manually operated from control panel.
- d) Sensor base with built-in electronic alarm sounder - All standard base features and piezoelectric sounder shall provide high output (88 dBA) with low current requirements (20 mA). Sounder shall be synchronized via SLC

- communications or by the NAC if NAC powered, sounder shall operation shall be programmable and shall be manually operated from control panel.
- e) 520 Hz Sensor base with built-in electronic low frequency sounder - All standard base features and piezoelectric sounder shall provide a low frequency 520 Hz Square Wave (85 dBA) with nominal current requirements (115 mA). Sounder shall be synchronized via SLC communications or by the NAC if NAC powered, sounder operation shall be programmable and shall be manually operated from control panel.
- (a) Emitted tone shall be a 520Hz Square Wave signal in compliance with the requirements of the 2010 edition of NFPA 72 for sleeping areas.
- (b) The 520Hz Sounder base shall be listed to UL 268 and UL464, Audible Signal Appliances.

### C. ADDRESSABLE HEAT SENSORS

1. General Requirements for Heat Detectors: Comply with UL 521.
2. Thermal Sensor Combination type: Fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
3. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag. Selectable rate compensated, fixed temperature sensing with or without rate-of-rise operation.
4. Mounting: Twist-lock base interchangeable with smoke-sensor heads.
5. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
6. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACU for either 15-deg F or 20-deg F per minute.
7. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.
8. Unless otherwise indicated, sensors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for temperature by fire-alarm control unit.
  - a) Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
  - b) Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).

### D. ADDRESSABLE CO SENSOR

1. Addressable CO Sensor

- a) The CO Sensor shall be an addressable carbon monoxide (CO) sensing module providing both CO toxic gas detection and enhanced fire detection, and shall be listed to UL 268, Smoke Detectors for Fire Alarm Signaling Systems and UL 2075, Gas and Vapor Detectors and Sensors; allowing systems to be listed to UL 2034, Single and Multiple Station Carbon Monoxide Alarms.
- b) The CO Sensor shall include CO sensor element mounted in the sensor base which can be easily replaced without replacing the complete sensor base assembly.
- c) The CO Sensor base shall provide address selection in the base allowing the address to remain with its location when the sensor is removed for service or type change.
- d) The CO Sensor base shall include an integral red LED to indicate the power-on, trouble, test mode or alarm status.
- e) CO sensor shall provide enhanced fire detection with the addition of two selectable modes of operation: Nuisance Alarm Reduction Mode and Faster Fire Detection.
- f) The CO Sensor shall provide a 10-year life expectancy before replacement is necessary or required.
- g) The CO Sensor base shall report the following CO Sensor troubles: Communication loss, Disabled, Almost Expired 12 Months, Almost Expired 6 Months, expired (End of Life), and Sensor Missing/Failed.

## 2. Addressable CO Sensor Sounder Base

- a) The CO Sensing element shall support operation with a Sounder base; the CO Sensor Sounder base shall provide temporal code 3 (TC3) for fire, or temporal code 4 (TC4) for toxic carbon monoxide alarms.
- b) The CO Sensor Sounder base shall be listed to UL464, Audible Signal Appliances.
- c) CO sensor shall provide enhanced fire detection with the addition of two selectable modes of operation: Nuisance Alarm Reduction Mode and Faster Fire Detection.
- d) The CO Sensor Sounder Base shall include CO sensor element mounted in the sounder base which can be easily replaced without replacing the complete sensor base assembly.
- e) The CO Sensor Sounder base shall provide address selection in the base allowing the address to remain with its location when the sensor is removed for service or type change.
- f) The CO Sensor Sounder Sensor base shall include an integral red LED to indicate the power-on, trouble, test mode or alarm status.
- g) The CO Sensor Sounder base shall report the following CO Sensor troubles: Communication loss, Disabled, Almost Expired 12 Months, Almost Expired 6 Months, Expired (End of Life), and Sensor Missing/Failed.
- h) The CO Sensor Sounder Base shall be interchangeable with the CO Sensor 520 Hz Sounder Base.

## 3. Addressable CO Sensor 520 Hz Sounder Base

- a) The CO Sensing element shall support operation with a 520 Hz Sounder base; the 520 Hz CO Sounder base shall provide temporal code 3 (TC3) for fire, or temporal code 4 (TC4) for toxic carbon monoxide alarms.
- b) Emitted tone shall be a 520Hz Square Wave signal in compliance with the requirements of the 2010 edition of NFPA 72 for sleeping areas.

- c) The CO Sensor 520Hz Sounder base shall be listed to UL 268 and UL464, Audible Signal Appliances.
- d) CO sensor shall provide enhanced fire detection with the addition of two selectable modes of operation: Nuisance Alarm Reduction Mode and Faster Fire Detection.
- e) The CO Sensor 520 Hz Sounder Base shall include CO sensor element mounted in the sounder base which can be easily replaced without replacing the complete sensor base assembly.
- f) The CO Sensor 520 Hz Sounder base shall provide address selection in the base allowing the address to remain with its location when the sensor is removed for service or type change.
- g) The CO Sensor 520 Hz Sounder base shall include an integral red LED to indicate the power-on, trouble, test mode or alarm status.
- h) The CO Sensor 520 Hz Sounder base shall report the following CO Sensor troubles: Communication loss, Disabled, Almost Expired 12 Months, Almost Expired 6 Months, expired (End of Life), and Sensor Missing/Failed.
- i) The CO Sensor 520 Hz Sounder Base shall be interchangeable with the standard CO Sensor Sounder Base.

E. ADDRESSABLE MULTI-POINT/MULTI-SENSOR/MULTI-CRITERIA SENSOR

1. Smoke and heat sensing shall be available to be combined in a single housing to provide smoke activity accurately monitored by photoelectric sensing technology and thermal activity accurately monitored by thermistor sensing technology.
2. A correlation algorithm of smoke activity and thermal activity shall be provided for intelligent fire detection earlier than with either technology activity alone but shall provide software and programming capabilities to help reduce nuisance alarms.
3. Individual sensor information shall be processed by the host fire alarm control unit to determine sensor status and to determine whether conditions are normal, off-normal, or alarm.
4. Analog information from each sensor type shall be digitally communicated to the control panel where it is to be analyzed. Photoelectric sensor input is to be stored and tracked as an average value with an alarm or abnormal condition being determined by comparing the sensor's present value against its average value. Thermal data is to be processed to look for absolute or rate-of-rise temperature as desired.
5. Monitoring each photoelectric sensor's average value shall provide a software filtering process that compensates for environmental factors (dust, dirt, etc.) and component aging, which shall provide an accurate reference for evaluating new activity. The intent of this process is to be a significant reduction in the probability of false or nuisance alarms caused by shifts in sensitivity, either up or down. Status indications of dirty and excessively dirty shall be automatically generated allowing maintenance to be performed on a per device basis.
6. Peak activity per sensor shall be stored by the host fire alarm control unit to assist in evaluating specific locations where the alarm set point for each sensor shall be capable of being determined at the control panel, and selectable as more or less

sensitive as the individual application requires.

7. Alarm set points shall be programmed for timed automatic sensitivity selection (such as more sensitive at night, less sensitive during day). Control panel programming shall also provide multi-stage operation per sensor, for example a 0.2% level may cause a warning to prompt investigation while a 2.5% level may initiate an alarm.
8. Combination smoke and heat sensors Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute. The fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
9. Bases: CO Sensor, relay output, sounder, 520 Hz Sounder, and isolator bases shall be supported alternatives to the standard base.

#### F. ADDRESSABLE CIRCUIT INTERFACE MODULES

1. Addressable Circuit Interface Modules: Arrange to monitor or control one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of AHU systems.
2. Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line circuit or a separate two wire pair running from an appropriate power supply, as required.
3. There shall be the following types of modules:
  - a) Type 1: Monitor Circuit Interface Module:
    - (a) For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACU.
    - (b) For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACU.
  - b) Type 2: Line Powered Monitor Circuit Interface Module
    - (a) This type of module is an individually addressable module that has both its power and its communications supplied by the two wire signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACU.
    - (b) This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire

signaling line circuit shall supply power and communications to the module.

c) Type 3: Single Address Multi-Point Interface Modules

(a) This multipoint module shall provide location specific addressability for four initiating circuits and control two output relays from a single address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited, and short). The input circuits and output relay operation shall be controlled independently and disabled separately.

(b) This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited, and short). The two-wire signaling line circuit shall supply power and communications to the module.

(c) This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The two-wire signaling line circuit shall supply power and communications to the module.

d) Type 4: Line Powered Control Circuit Interface Module

(a) This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and communications to the module.

e) Type 5: 4-20 mA Analog Monitor Circuit Interface Module

(a) This module shall communicate the status of a compatible 4-20 mA sensor to the FACU. The FACU shall annunciate up to three threshold levels, each with custom action message; display and archive actual sensor analog levels; and permit sensor calibration date recording.

4. All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACU. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

## 2.5 CONVENTIONAL INITIATING

### A. CONVENTIONAL MANUAL PULL STATIONS

1. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
2. Description: Conventional single- action type, red LEXAN. Station shall mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units. Station shall be pull-lever type; with

integral terminal strip to accommodate wiring connections to fire-alarm control unit Initiating Device Circuit. Where double-action stations are provided, the mechanism shall require two actions break front glass to initiate an alarm.

3. Indoor Protective Shield: Where required, or as indicated on the drawings, provide a factory-fabricated, tamperproof, clear LEXAN enclosure shield and red frame that easily fits over manual pull stations which shall be hinged at the top to permit lifting for access to initiate a local alarm. Unit shall be NRTL listed. Lifting the cover shall actuate an integral battery-powered audible horn intended to discourage false-alarm operation. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

## 2.6 ADDRESSABLE NOTIFICATION

### A. ADDRESSABLE ALARM NOTIFICATION APPLIANCES

1. Addressable Notification Appliances: The Contractor shall furnish and install Addressable Notification Appliances and accessories to operate on compatible signaling line circuits (SLC).
  - a) Addressable Notification appliance operation shall provide power, supervision and separate control of horns and strobes over a single pair of wires. The controlling channel (SLC) digitally communicates with each appliance and receives a response to verify the appliance's presence on the channel. The channel provides a digital command to control appliance operation. SLC channel wiring shall be unshielded twisted pair (UTP), with a capacitance rating of less than 60pf/ft and a minimum 3 twists (turns) per foot.
  - b) All Notification Appliances shall operate as a completely independent device allowing for specific location alerting of both fire alarm and Mass Notification functions. Each visible device (both clear fire alarm and amber mass notification) shall be capable of operating on multiple notification zones or completely separate from all other notification devices, this allows "On the fly" program operation changes for Mass Notification alerting and fire alarm notification.
  - c) All Notification Appliances shall operate as a completely independent device allowing for appliances in handicap accessible rooms and other locations to operate on the same SLC and to activate individually based on an alarm condition in a room or as part of a general alarm condition where all appliances activate together.
  - d) Individual Notification Appliances shall be able to be grouped into zones (or operational groups) by central programming at the main fire alarm control unit.
  - e) Notification Appliances shall provide for "unobtrusive" testing. Each Notification Appliance shall be tested for audible and visible operation on an individual basis at the device or from the main fire alarm control unit, allowing for minimal invasive impact.
  - f) Class B (Style 4) notification appliances shall be wired without requiring

- traditional in/out wiring methods; addressable "T" Tapping shall be permitted. Up to 127 addresses can be supported on a single channel.
- g) Each Addressable notification appliance shall contain an electronic module and a selectable address setting to allow it to occupy a unique location on the channel. This on-board module shall also allow the channel to perform appliance diagnostics that assist with installation and subsequent test operations. A visible LED on each appliance shall provide verification of communications and shall flash with the appliances address setting when locally requested using a magnetic test tool.
  - h) Each addressable notification appliance shall have electrical test point access without removing the device cover.
  - i) Both wall mount and ceiling mount devices shall be available.
2. Addressable Horn: Addressable horn shall be listed to UL 464. Horn shall support Temporal Code 3, March Time (20, 60, or 120 BPM), Continuous, and Temporal Code 4 coding patterns. Horn appliances shall have a High/Low Setting, programmable by channel from the addressable controller or by appliance from the host FACU. The horn shall have a minimum sound pressure level of 83 or 89 dBA for steady) or of 79 or 85 dBA for coded operation. The horn device shall consist of three pieces; appliance, cover and mounting plate. For ease of installation the mounting plate shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings. When the appliance is connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot.
  3. Addressable Visible/Only: Addressable strobe shall be listed to UL 1971. The V/O device shall consist of a xenon flash tube and associated lens/reflector system, cover and mounting plate. For ease of installation the mounting plate shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. When the appliance is connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. The V/O appliance shall be provided with multiple minimum flash intensities of 15cd, 30cd, 75cd, 110cd, 135cd and 185cd. The Candela levels shall be settable from the fire alarm control unit or by using a hardware selector on the appliance.
  4. Addressable Audible/Visible: Addressable combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe device shall consist of a xenon flash tube and associated lens/reflector system, cover and mounting plate. For ease of installation audible/visible mounting plate shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. The strobe shall provide multiple minimum flash intensities of 15cd, 30cd, 75cd, 110cd, 135cd and 185cd. The Candela levels shall be settable from the fire alarm control unit or using a hardware selector on the appliance. The Horn shall support Temporal Code 3, March Time (20, 60, or 120 BPM), Continuous, and Temporal Code 4 coding patterns. The horn shall have a minimum sound pressure level of 83 or 89 dBA for steady or 79 or 85 dBA for coded operation. When the appliance is connected

to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. The appliance shall be capable of two-wire synchronization with one of the following options:

- a) Synchronized Strobe with Horn on steady.
- b) Synchronized Strobe with Temporal Code Pattern on Horn.
- c) Synchronized Strobe with March Time cadence on Horn.
- d) Synchronized Strobe firing to NAC sync signal with Horn silenced.

5. Addressable Multi-Tone Audible Only: Addressable multi-tone appliance shall be listed to UL 464. Per appliance tone selection of 520 Hz Horn, Broadband Horn, Bell, and Chime tones shall be controlled as Temporal Code 3, Temporal Code 4, March Time (selectable as 20, 60, or 120 bpm), or Continuous shall be programmable from the control panel, or selected using an on-board DIP Switch. Slow Whoop, Siren, and High/Low tone selections shall be controlled as synchronized continuous operation. Appliances shall have a High/Low Setting, programmable by channel from the addressable controller or by appliance from the host FACU. 520 Hz tone shall be compliant with NFPA 72 Low Frequency Signal Requirements for Sleeping Areas. The appliance shall consist of three pieces; appliance, cover and mounting plate. For ease of installation the mounting plate shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings. When the appliance is connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit.
6. Addressable Multi-Tone Audible/Visible: Addressable combination Multi-Tone Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe device shall consist of a xenon flash tube and associated lens/reflector system, cover and mounting plate. For ease of installation audible/visible mounting plate shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. The strobe shall provide multiple minimum flash intensities of 15cd, 30cd, 75cd, 110cd, 135cd and 185cd. The Candela levels shall be settable from the fire alarm control unit or using a hardware selector on the appliance. Per appliance tone selection of 520 Hz Horn, Broadband Horn, Bell, and Chime tones shall be controlled as Temporal Code 3, Temporal Code 4, March Time (selectable as 20, 60, or 120 bpm), or Continuous shall be programmable from the control panel, or selected using an on-board DIP Switch. Slow Whoop, Siren, and High/Low tone selections shall be controlled as synchronized continuous operation. Appliances shall have a High/Low Setting, programmable by channel from the addressable controller or by appliance from the host FACU. 520 Hz tone shall be compliant with NFPA 72 Low Frequency Signal Requirements for Sleeping Areas.
7. Addressable Weatherproof Visible Only: Addressable weatherproof strobe shall be UL 1971 listed for indoor applications with strobe intensity selectable as 15 or 75 cd or UL 1638 listed for outdoor applications with strobe rated at 75 cd (WP75) or 185 cd (WP185). The appliances shall be acceptable for indoor and outdoor, extended temperature and extended humidity applications. The V/O device shall consist of a xenon flash tube and associated lens/reflector system, weatherproof

cover and weatherproof mounting box. The V/O appliance shall be provided with multiple minimum flash intensities of 15, 75, WP 75, or WP 185 candela. The Candela levels shall be settable from the fire alarm control unit or by using a hardware selector on the appliance.

8. Addressable Weatherproof Audible/Visible: Addressable weatherproof horn/strobe shall be UL 464 and UL 1971 listed for indoor applications with strobe intensity selectable as 15 or 75 cd or UL 1638 listed for outdoor applications with strobe rated at 75 cd (WP75) or 185 cd (WP185).. The appliances shall be acceptable for indoor and outdoor, extended temperature and extended humidity applications. The A/V device shall consist of a xenon flash tube and associated lens/reflector system, weatherproof cover and weatherproof mounting box. The strobe appliance shall be provided with multiple minimum flash intensities of 15, 75, WP 75, or WP 185 candela. The Candela levels shall be settable from the fire alarm control unit or by using a hardware selector on the appliance. The Horn shall support Temporal Code 3, March Time (20, 60, or 120 BPM), Continuous, and Temporal Code 4 coding patterns. The horn shall have a minimum sound pressure level of 81 or 87 dBA for steady or 80 or 87 dBA for coded operation.
9. Addressable Mini-Horn Audible Only: Addressable mini-horn shall be listed to UL 464. Horn shall support Temporal Code 3, March Time (20, 60, or 120 BPM), Continuous, and Temporal Code 4 coding patterns. Mini-horn appliances shall have a High/Low Setting, selectable at the appliance or programmable from the addressable controller by appliance from the host FACU. The horn shall have a minimum sound pressure level of 85 or 87 dBA for steady) or of 81 or 83 dBA for coded operation. The horn device shall consist of two pieces; cover and appliance/mounting plate. For ease of installation the appliance/mounting plate shall mount directly to a standard single gang electrical box, without the use of special adapter or trim rings. When the appliance is connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. Weatherproof model shall mount to provided single gang weatherproof electrical box.
10. Addressable LED Visible Only: Addressable LED visible strobe (V/O) shall be listed to UL 1971. The multi-candela LED V/O strobe device shall be available in low (15, 30, 75 cd) and high (110, 135, 185 cd) range candela. Models shall provide a small compact design with low current draw due to efficient strobe LED's. LED strobe device shall consist of two pieces; cover and appliance/mounting plate. For ease of installation the appliance/mounting plate shall mount directly to a standard single gang electrical box, without the use of special adapter or trim rings. Synchronized LED strobe operation shall be provided with other LED or Xenon strobe devices on the same circuit or the same panel on different circuits. LED strobe device shall meet the 20ms pulse width requirement in the 2016 Edition of NFPA 72. When the appliance is connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. The Candela levels shall be settable from the fire alarm control unit or by using a hardware selector on the appliance. Weatherproof model shall mount to provided single gang weatherproof electrical box.

11. Addressable LED Audible/Visible: Addressable combination LED Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. Horn shall support Temporal Code 3, March Time (20, 60, or 120 BPM), Continuous, and Temporal Code 4 coding patterns. Horn shall have a High/Low Setting, selectable at the appliance or programmable from the addressable controller by appliance from the host FACU. The horn shall have a minimum sound pressure level of 85 or 87 dBA for steady) or of 81 or 83 dBA for coded operation. The multi-candela LED V/O strobe device shall be available in low (15, 30, 75 cd) and high (110, 135, 185 cd) range candela. Models shall provide a small compact design with low current draw due to efficient strobe LED's. Synchronized LED strobe operation shall be provided with other LED or Xenon strobe devices on the same circuit or the same panel on different circuits. LED strobe device shall meet the 20ms pulse width requirement in the 2016 Edition of NFPA 72. The A/V device shall consist of two pieces; cover and appliance/mounting plate. For ease of installation the appliance/mounting plate shall mount directly to a standard single gang electrical box, without the use of special adapter or trim rings. When the appliance is connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. Weatherproof model shall mount to provided single gang weatherproof electrical box.
  
12. Isolator Module: Isolator module provides short circuit isolation for addressable notification appliance SLC wiring. Isolator shall be listed to UL 864. The Isolator shall mount directly to a minimum 2 1/8" deep, standard 4" square electrical box, without the use of special adapter or trim rings. Power and communications shall be supplied by the Addressable Controller channel SLC; dual port design shall accept communications and power from either port and shall automatically isolate one port from the other when a short circuit occurs. The following functionality shall be included in the Isolator module:
  - a) Report faults to the host FACU.
  - b) On-board Yellow LED provides module status.
  - c) After the wiring fault is repaired, the Isolator modules shall test the lines and automatically restore the connection.
  
13. Addressable Textual Notification Appliance: Textual Notification Appliance is to operate on a compatible Signaling Line Circuit (SLC) and is to provide a high visibility, multi-color LED text message display.
  - a) Textual Notification Appliance shall be Listed to UL 1638 Visual Signaling Appliances.
  - b) Appliance shall be capable of up to thirty two (32) pre-programmed message selections that can be activated in response to pre-defined emergency situations or linked to specific system point status conditions.
  - c) Textual Notification Appliance shall be capable of displaying dual or single line emergency instructions. Instructions can show as static, flashing, or scrolling with a variety of appearance/transition options. Instructions shall be capable of displaying using multi-colors to emphasize instructions content.
  - d) Textual Notification Appliance shall be capable of providing non-emergency information during non-emergency conditions. Emergency conditions will override non-emergency message/instructions and display emergency instructions.

- e) Textual Notification Appliance shall be capable of scrolling instructions of at least 512 characters in length.
- f) Textual Notification Appliance shall be viewable from a distance of 100 feet.
- g) Textual Notification Appliance shall be powered by a listed fire alarm power supply providing 24VDC with battery back-up.
- h) Textual Notification Appliance shall be capable of wall or ceiling mounting options.

14. Accessories: The contractor shall furnish the necessary accessories.

## 2.7 CONVENTIONAL NOTIFICATION

### A. STANDARD ALARM NOTIFICATION APPLIANCES

1. Horn: Piezoelectric type horn shall be listed to UL 464. The horn shall have a minimum sound pressure level of 85 dBA @ 24VDC. The horn shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings.
2. Visible/Only: Strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. V/O appliances shall be provided with different minimum flash intensities of 15cd, 30cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.
3. High Intensity Visible/Only: High Intensity Visible/Only: Visible/Only: Strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O appliance shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. V/O appliances shall be provided with different minimum flash intensities of 135cd, 177cd and 185cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.
4. Audible/Visible: Combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. The horn shall have a minimum sound pressure level of 85 dBA @ 24VDC. The audible/visible enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings.
5. High Intensity Audible/Visible: Combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. Strobe appliances shall be provided with different minimum flash intensities of 135cd, 177cd and 185cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. The horn shall have a minimum sound pressure level of 85 dBA @ 24VDC. The audible/visible appliance shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters

or trim rings.

6. Multi-Tone Audible Only: Multi-tone appliance shall be listed to UL 464. Per appliance tone selection of 520 Hz Horn, Broadband Horn, Bell, Chime, High/Low, Slow Whoop, or Siren shall be selected using an on-board DIP Switch. Output level shall be selectable as high or low. 520 Hz tone shall be compliant with NFPA 72 Low Frequency Signal Requirements for Sleeping Areas. For ease of installation the appliance shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings.
7. Multi-Tone Audible/Visible: Combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system and shall be provided with different minimum flash intensities of 15cd, 30cd, 75cd, 110cd, 135, and 185 candela. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. Multi-tone appliance shall be listed to UL 464. Per appliance tone selection of 520 Hz Horn, Broadband Horn, Bell, Chime, High/Low, Slow Whoop, or Siren shall be selected using an on-board DIP Switch. Output level shall be selectable as high or low. 520 Hz tone shall be compliant with NFPA 72 Low Frequency Signal Requirements for Sleeping Areas. For ease of installation the appliance shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings.
8. Weatherproof Visible Only: Weatherproof strobe shall be UL 1971 listed for indoor applications with strobe intensity selectable as 15, 60, or 75 cd or UL 1638 listed for outdoor applications with strobe rated at 75 cd (WP75). The appliances shall be acceptable for indoor and outdoor, extended temperature and extended humidity applications. The V/O device shall consist of a xenon flash tube and associated lens/reflector system, weatherproof cover and weatherproof mounting box. The Candela levels shall be selectable by using a hardware selector on the appliance.
9. Weatherproof Audible/Visible: Weatherproof horn/strobe shall be UL 464 and UL 1971 listed for indoor applications with strobe intensity selectable as 15, 60, or 75 cd or UL 1638 listed for outdoor applications with strobe rated at 75 cd (WP75). The appliances shall be acceptable for indoor and outdoor, extended temperature and extended humidity applications. The A/V device shall consist of a xenon flash tube and associated lens/reflector system, weatherproof cover and weatherproof mounting box. The Candela levels shall be selectable by using a hardware selector on the appliance. The Horn shall support Temporal Code 3, March Time (20, 60, or 120 BPM), Continuous, and Temporal Code 4 coding patterns. The horn shall have a minimum sound pressure level of 79 dBA for coded operation at 24 VDC.
10. Notification Appliance Circuit provides synchronization of strobes at a rate of 1Hz and operates horns with a Temporal Code Pattern operation. The circuit shall provide the capability to silence the audible signals, while the strobes continue to flash, over a single pair of wires. The capability to synchronize multiple notification appliance circuits shall be provided.

11. Accessories: The contractor shall furnish any necessary accessories.

## 2.8 REMOTE LCD ANNUNCIATOR

- A. Provide a remote LCD Annunciator, where required, with the same "look and feel" as the FACU operator interface. The Remote LCD Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys; Status LEDs and LCD Display as the FACU.
- B. Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with four (4) programmable control switches and associated LEDs.
- C. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.
- D. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.
- E. The LCD shall display the following information relative to the abnormal condition of a point in the system:
  - 1. 40 character custom location label.
  - 2. Type of device (e.g., smoke, pull station, waterflow).
  - 3. Point status (e.g., alarm, trouble).
- F. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACU.

## 2.9 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address or loss of power.
4. Low battery.
5. Abnormal test signal.
6. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

## 2.10 RADIO ALARM TRANSMITTER

- A. Transmitter shall comply with NFPA 1221 and shall be listed and labeled by an NRTL.
- B. Comply with 47 CFR 90.
- C. Description: Manufacturer's standard commercial product; factory assembled, wired, tested, and ready for installation and operation.
  1. Packaging: A single, modular, NEMA 250, Type 1 metal enclosure with a tamper-resistant flush tumbler lock.
  2. Signal Transmission Mode and Frequency: VHF or UHF 2-W power output, coordinated with operating characteristics of the established remote alarm receiving station designated by Owner.
  3. Normal Power Input: 120-V ac.
  4. Secondary Power: Integral-sealed, rechargeable, 12-V battery and charger. Comply with NFPA 72 requirements for battery capacity; submit calculations.
  5. Antenna: Omnidirectional, coaxial half-wave, dipole type with driving point

impedance matched to transmitter and antenna cable output impedance. Wind-load strength of antenna and mounting hardware and supports shall withstand 100 mph (160 km/h) with a gust factor of 1.3 without failure.

6. Antenna Cable: Coaxial cable with impedance matched to the transmitter output impedance.
  7. Antenna-Cable Connectors: Weatherproof.
  8. Alarm Interface Devices: Circuit boards, modules, and other auxiliary devices, integral to the transmitter, matching fire-alarm and other system outputs to message-generating inputs of the transmitter that produce required message transmissions.
- D. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit or from its own internal sensors or controls and shall automatically transmit signal along with a unique code that identifies the transmitting station to the remote alarm receiving station. Transmitted messages shall correspond to standard designations for fire-reporting system to which the signal is being transmitted and shall include separately designated messages in response to the following events or conditions:
1. Transmitter Low-Battery Condition: Sent when battery voltage is below 85 percent of rated value.
  2. System Test Message: Initiated manually by a test switch within the transmitter cabinet, or automatically at an optionally preselected time, once every 24 hours, with transmission time controlled by a programmed timing device integral to transmitter controls.
  3. Transmitter Trouble Message: Actuated by failure, in excess of one-minute duration, of the transmitter normal power source, derangement of the wiring of the transmitter, or any alarm input interface circuit or device connected to it.
  4. Local Fire-Alarm-System Trouble Message: Initiated by events or conditions that cause a trouble signal to be indicated on the building system.
  5. Local Fire-Alarm-System Alarm Message: Actuated when the building system goes into an alarm state. Identifies device that initiated the alarm.
  6. Local Fire-Alarm-System Supervisory-Alarm Message: Actuated when the building alarm system indicates a supervisory alarm.

## 2.11 AUTOCALL SYSTEM INTERFACE

- A. When a fire alarm system using existing autocal loop devices requires expansion, the FACU shall be capable of interfacing to the loop via an interface module. This module shall allow the FACU to be selected to function as either the loop master controller (head end) or as a Data Gathering Panel as an intelligent device on the loop reporting to a remote master controller. Multiple Loop Interface Modules can be installed in the FACU allowing a variety of system expansion situations to be

satisfied.

## 2.12 EMERGENCY POWER SUPPLY

- A. General: Components include battery, charger, and an automatic transfer switch.
- B. Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm notification devices in alarm mode for a period of 15 minutes.

## 2.13 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
  - 1. Factory fabricated and furnished by manufacturer of device.
  - 2. Finish: Paint of color to match the protected device.

# PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

- A. Install system components and all associated devices in accordance with applicable NFPA Standards and manufacturer's recommendations.
- B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:
  - 1. Factory trained and certified personnel.
  - 2. National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.
  - 3. Personnel licensed or certified by state or local authority.

## 3.2 EQUIPMENT INSTALLATION

- A. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, Ethernet drops, and all other necessary material for a complete operating system.
- B. Existing Fire Alarm Equipment shall be maintained fully operational until the new equipment has been tested and accepted.
- C. Equipment Removal: After acceptance of the new fire alarm system, disconnect and remove the existing fire alarm equipment and restore damaged surfaces. Package

operational fire alarm and detection equipment that has been removed and deliver to the Owner. Remove from the site and legally dispose of the remainder of the existing material.

- D. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.
- E. Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.
- F. Install manual station with operating handle 48 inches (1.22 m) above floor. Install wall mounted audible and visual notification appliances not less than 80 inches (2.03 m) above floor to bottom of lens and not greater than 96 inches (2.44 m) above floor to bottom of lens.
- G. Mount outlet box for electric door holder to withstand 80 pounds pulling force.
- H. Make conduit and wiring connections to door release devices, sprinkler flow switches, sprinkler valve tamper switches, fire suppression system control units, duct smoke detectors.
- I. Automatic Detector Installation: Conform to NFPA 72.
- J. Ethernet Drop: A standard RJ-45 Ethernet connection to the owner's Ethernet network shall be provided at each fire alarm control unit as part of the contract.

### 3.3 PREPARATION

- A. Coordinate work of this Section with other affected work and construction schedule.

### 3.4 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
  - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
  - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
  - 3. Smoke dampers in air ducts of designated air-conditioning duct systems.
  - 4. Alarm-initiating connection to elevator recall system and components.

5. Alarm-initiating connection to activate emergency lighting control.
6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
7. Supervisory connections at valve supervisory switches.
8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
9. Supervisory connections at elevator shunt trip breaker.

### 3.5 WIRING INSTALLATION

- A. System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC).
- B. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.
- C. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.
- D. Mount end-of-line device in box with last device or separate box adjacent to last device for Class "B" supervision.
- E. Ethernet Circuits:
  1. Ethernet circuits shall be provided to the Fire Alarm Control Unit as shown on the plans.
  2. Where a dedicated Fire Alarm Ethernet LAN is specified only Agency Listed Fire Alarm Ethernet hardware shall be installed.
  3. The electrical contractor shall coordinate and ensure proper Ethernet connections occur at the fire alarm control unit and other designated equipment locations prior to system turnover.

### 3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

### 3.7 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100.  
Install a ground wire from main service ground to fire-alarm control unit.

### 3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:

1. Factory trained and certified.
2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.
3. International Municipal Signal Association (IMSA) fire alarm certified.
4. Certified by a state or local authority.
5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.

C. Pretesting: Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.

D. Inspection:

1. Inspect equipment installation, interconnection with system devices, mounting locations, and mounting methods.
2. Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.

E. Acceptance Operational Tests:

1. Perform operational system tests to verify conformance with specifications:
  - a) Each alarm initiating device installed shall be operationally tested. Each device shall be tested for alarm and trouble conditions. Contractor shall submit a written certification that the Fire Alarm System installation is complete including all punch-list items. Test battery operated emergency power supply. Test emergency power supply to minimum durations

specified. Test Supervising Station Signal Transmitter. Coordinate testing with Supervising Station monitoring firm/entity.

- b) Test each Notification Appliance installed for proper operation. Submit written report indicating sound pressure levels at specified distances.
- c) Test Fire Alarm Control Unit and Remote Annunciator.

2. Provide minimum 10 days notice of acceptance test performance schedule to Owner, and local Authority Having Jurisdiction.

F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Use NFPA 72 Forms for documentation.

H. Final Test, Record of Completion, and Certificate of Occupancy:

- 1. Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy. Provide completed NFPA 72 Record of Completion form to Owner and AHJ.

### 3.9 DEMONSTRATION

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

### 3.10 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.

B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound pressure levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

### 3.11 TRAINING

A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.

- 1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 8 hours' training.
- 2. Schedule training with the Owner at least seven days in advance.

B. References

- 1. The Seller shall provide four references. References must include equipment similar to the requirements included in this section.

### C. Warranty/Service Availability

1. The seller shall explain their local warranty and service capability that's available from the seller's local office. Warranty and Service Information shall include:
  - a) Preventative Maintenance
  - b) Local Trained Technicians
  - c) Repair Parts
  - d) A Strategy for resolving system malfunctions during business hours, non-business hours, and weekends
  - e) A Process of tracking service calls and escalation of recurring problems.

### D. Staffing and Management

1. The seller shall provide a description of their local office personnel.
2. The seller shall describe their local Project Management capability, Service and Installation Personnel.
3. The seller shall describe additional resources (i.e. Corporate, Manufacturing, Quality Assurance Resources).

### E. Scope of Work

1. The seller shall describe their design and phasing approach on this fire alarm system upgrade project. Please describe your system design, project management approach, professional installation services, and technical installer support. Also, include a fire alarm system test procedure.

### F. Safety

1. The seller shall explain why safety is important on this type of installation project. The Seller shall appoint an accountable safety foreman on this project. An overview of a safety plan must be described.

### G. Training

1. The seller shall demonstrate their ability to meet both on-site and off-site fire alarm operation and maintenance training.

### H. Quality Assurance/Quality Control Plan

1. The seller shall provide a Quality Assurance/Quality Control Plan.
2. Please provide the name of the project's site foreman and describe their assigned project responsibilities. The assigned foreman must be NICET certified for the installation and maintenance of fire alarm systems.
3. Please explain how quality is implemented in both Project Management and Technical Installation Support on this project. The seller shall provide start-up procedures, construction procedures, and close-out procedures for this fire alarm system upgrade project.

4. The seller's processes must be ISO 9001 and ISO 9002 compliant. The seller shall provide their UL Certificate of Registration.
5. Please explain how defect prevention is conducted both in your manufacturing facility as well as with your existing fire alarm customers.
6. Please describe how Software Quality Assurance (SQA) and product life cycle development work together in the various stages of a new product.
7. The seller must demonstrate two problem-solving examples that show how their field office and the seller's headquarter manufacturing personnel work together to solve a fire alarm issue.

I. Cost

1. The seller shall provide a complete turnkey price for design/build and installation of a retrofit fire alarm system.

J. Central Monitoring

1. The Seller shall provide around the clock electronic monitoring for trouble and alarm conditions. Please describe the process used to notify agencies and/or individuals if a condition occurs. Note any value added features such as redundancy or technology enhancements.

K. Security Integration to the Proposed Fire Alarm System

1. The seller shall provide an optional overview of a security access control platform that integrates to the proposed fire alarm system. The seller shall describe the variety of network solutions that are available for this security platform (i.e. dedicated fault tolerant network, Ethernet Network, Wide Area Network.)

END OF SECTION 28 31 12

SECTION 311000 - SITE  
CLEARING

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removing above- and below-grade site improvements.
2. Disconnecting, capping, or sealing site utilities.
3. Temporary erosion and sedimentation control.

1.2 PREINSTALLATION MEETINGS

1.3 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- C. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

SECTION 311000 - SITE  
CLEARING

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Protect existing site improvements to remain from damage during construction.
  - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
  - 1. Arrange with utility companies to shut off indicated utilities.
- B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Architect's written permission.
- C. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition."

SECTION 311000 - SITE  
CLEARING

3.4 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

3.5 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 311000

SECTION 321216 - ASPHALT  
PAVING

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hot-mix asphalt paving.
2. Hot-mix asphalt overlay.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for concrete pavement and for separate concrete curbs, gutters, and driveway aprons.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Hot-mix asphalt designs.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of of NYS DOT for asphalt paving work.
1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. Coarse Aggregate: ASTM D692/D692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- B. Fine Aggregate: ASTM D1073 , sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

SECTION 321216 - ASPHALT  
PAVING

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: ASTM D6373 or binder designation NYS DOT .
- B. Tack Coat: ASTM D977 or emulsified asphalt, or ASTM D2397/D2397M or cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 AUXILIARY MATERIALS

- A. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

2.4 MIXES

- A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:
  - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
  - 2. Base Course: See Drawings .
  - 3. Binder Course: See Drawings .
  - 4. Surface Course: See Drawings .

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Ensure that prepared subgrade is ready to receive paving. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces.
- B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.2 HOT-MIX ASPHALT PLACEMENT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
  - 1. Place hot-mix asphalt base course and binder course in number of lifts and thicknesses indicated.

SECTION 321216 - ASPHALT  
PAVING

2. Place hot-mix asphalt surface course in single lift.
  3. Spread mix at a minimum temperature of 250 deg F.
  4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### 3.3 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
  2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
  3. Offset transverse joints, in successive courses, a minimum of 24 inches.
  4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method in accordance with AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

### 3.4 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
1. Average Density, Rice Test Method: 92 percent of reference maximum theoretical density in accordance with ASTM D2041/D2041M, but not less than 90 percent or greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

SECTION 321216 - ASPHALT  
PAVING

- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.5 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce thickness indicated within the following tolerances:
  - 1. Base Course and Binder Course: Plus or minus 1/2 inch.
  - 2. Surface Course: Plus 1/4 inch, no minus.
- B. Pavement Surface Smoothness: Compact each course to produce surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
  - 1. Base Course and Binder Course : 1/4 inch .
  - 2. Surface Course: 1/8 inch .

END OF SECTION 321216

SECTION 321313 -  
CONCRETE PAVING

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes Concrete Paving

1. Driveways.
2. Curbs and gutters.
3. Walks.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.3 QUALITY ASSURANCE

A. 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").

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

SECTION 321313 -  
CONCRETE PAVING

2.2 STEEL REINFORCEMENT

- A. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, fabricated from as-drawn steel wire into flat sheets.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- C. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars ; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.

2.3 CONCRETE MATERIALS

- A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
  - 1. Portland Cement: ASTM C 150/C 150M, gray portland cement Type I/II .
  - 2. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33/C 33M, , uniformly graded. Provide aggregates from a single source.
- C. Air-Entraining Admixture: ASTM C 260/C 260M.
- D. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
- E. Water: Potable and complying with ASTM C 94/C 94M.

2.4 CURING MATERIALS

- A. Water: Potable.
- B. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation.
    - b. Brickform; a division of Solomon Colors.
    - c. ChemMasters, Inc.
    - d. Dayton Superior.
    - e. Euclid Chemical Company (The); an RPM company.
    - f. Kaufman Products, Inc.
    - g. Lambert Corporation.
    - h. Laticrete International, Inc.
    - i. Sika Corporation.
    - j. SpecChem, LLC.

SECTION 321313 -  
CONCRETE PAVING

- k. Vexcon Chemicals Inc.
- l. W.R. Meadows, Inc.

2.5 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.
- B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

2.6 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  - 1. Fly Ash or Pozzolan: 25 percent.
  - 2. Slag Cement: 50 percent.
  - 3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
  - 1. Air Content: 6 percent plus or minus 1-1/2 percent.
- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.
- F. Concrete Mixtures: Normal-weight concrete.
  - 1. Compressive Strength (28 Days): 4000 psi .
  - 2. Maximum W/C Ratio at Point of Placement: 0.45 .
  - 3. Slump Limit: 4 inches , plus or minus 1 inch.

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

SECTION 321313 -  
CONCRETE PAVING

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

- A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness:
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes.

SECTION 321313 -  
CONCRETE PAVING

3.6 CONCRETE PLACEMENT

- A. 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.
- B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- C. 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.
- D. Screed paving surface with a straightedge and strike off.
- E. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater 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.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- 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.

SECTION 321313 -  
CONCRETE PAVING

3.9 SEALER APPLICATION

- A. Clear Acrylic Sealer: Apply uniformly in two coats in continuous operations according to manufacturer's written instructions. Allow first coat to dry before applying second coat, at 90 degrees to the direction of the first coat, using same application methods and rates.
  - 1. Begin sealing dry surface no sooner than 14 days after concrete placement.

3.10 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
  - 1. Elevation: 3/4 inch.
  - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
  - 3. Surface: Gap below 10-foot- long; unlevelled straightedge not to exceed 1/2 inch.
  - 4. Joint Spacing: 3 inches.
  - 5. Contraction Joint Depth: Plus 1/4 inch, no minus.
  - 6. Joint Width: Plus 1/8 inch, no minus.

3.11 REPAIR AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321723 -  
PAVEMENT MARKINGS

SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Painted markings applied to asphalt paving.
  2. Painted markings applied to concrete surfaces.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data:
1. Pavement-marking paint, solvent-borne.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Dow Chemical Company (The).
  2. PPG Paints.
  3. Sherwin-Williams Company (The).

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" the ABA standards of the Federal agency having jurisdiction and ICC A117.1 .

2.3 PAVEMENT-MARKING PAINT

- A. Pavement-Marking Paint, Solvent-Borne: MPI #32, solvent-borne traffic-marking paint.
1. Color: Blue .

SECTION 321723 -  
PAVEMENT MARKINGS

PART 3 - EXECUTION

3.1 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow asphalt paving or concrete surfaces to age for a minimum of 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils .
  - 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to asphalt paving or concrete surface.

END OF SECTION 321723

## SECTION 32 31 00 – WOOD PRIVACY FENCES AND GATES

### Part 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Requirements regarding wood fencing and gates.

#### 1.2 SUBMITTALS

- A. Drawings: Indicate plan layout, grid, size and spacing of components, accessories, fittings, anchorage, and post section.
- B. Data: Submit manufacturer's installation instructions and procedures, including details of fence and gate installation.

### Part 2 PRODUCTS

#### 2.1 GENERAL

- A. All wood materials shall be treated wood, or wood of a natural resistance to decay. Materials shall be free from loose knots, cracks, and other imperfections.
- B. Cast-in-place Concrete: Class 3000 minimum, Section 03 30 04.

#### 2.2 WOOD BOARDS OR SLATS

- A. Wood boards or slats shall be of cedar, redwood, combed spruce.
- B. Wood boards or slats shall be between 3/8 inches and 5/8 inches thick and be no greater than 6 inches wide.

#### 2.3 POSTS

- A. Fence and Man Gate posts shall be 4-inch by 4-inch.
- B. Truck Gate posts shall be at minimum dual 6-inch by 6-inch or as recommended by manufacturer.
- C. Posts shall be pressure treated redwood, douglas fir-larch, cedar .
- D. Buried post ends should be treated with an approved wood preservative product.

#### 2.4 GATES

- A. Provide additional horizontal, vertical, and diagonal members to ensure proper gate operation and for attachment of wood, hardware and accessories. Consult manufacturer as necessary.
- B. Accessibility: Gate stops, latches and locks shall be accessible from either side of gate.
- C. Types: Man Gates and Truck Gates

1. Man Gates
  - a. Openings shall be a minimum of 3 feet wide.
2. Truck Gates
  - a. Openings shall be a minimum of 12 feet wide.

## 2.5 GATE HARDWARE

- A. Gate hardware including, but not limited to, latches, hinges, stops and bolts shall be stainless steel, powder coated black, or galvanized.
- B. Hinges and Pins shall be heavy duty and sized as per manufacturer's recommendations.
- C. For truck gates (double-leaf), a drop rod or stop shall be installed on one leaf, include at least one guide and shall extend into concrete base or similarly solid base.
- D. Dual access (accessible and lockable from either side) latch and lock systems are required on all gates.
  1. The following dual access latch and lock systems are allowed and must be approved in writing prior to installation:
    - a. Lock Thru™ Latch (website: <http://www.hooverfence.com/woodfence/lockthru.htm>);
    - b. Sure Latch (website: <http://surelatch.com/gate-latches/7-lockable-two-way-latch-and-pin.html>);
    - c. or Equal.

## Part 3 EXECUTION

### 3.1 INSTALLATION OF POSTS

- A. Posts shall be set true to line and grade.
- B. Set posts in 12-inch diameter concrete footings extending at least 24- inches into undisturbed natural ground or properly compacted fill.

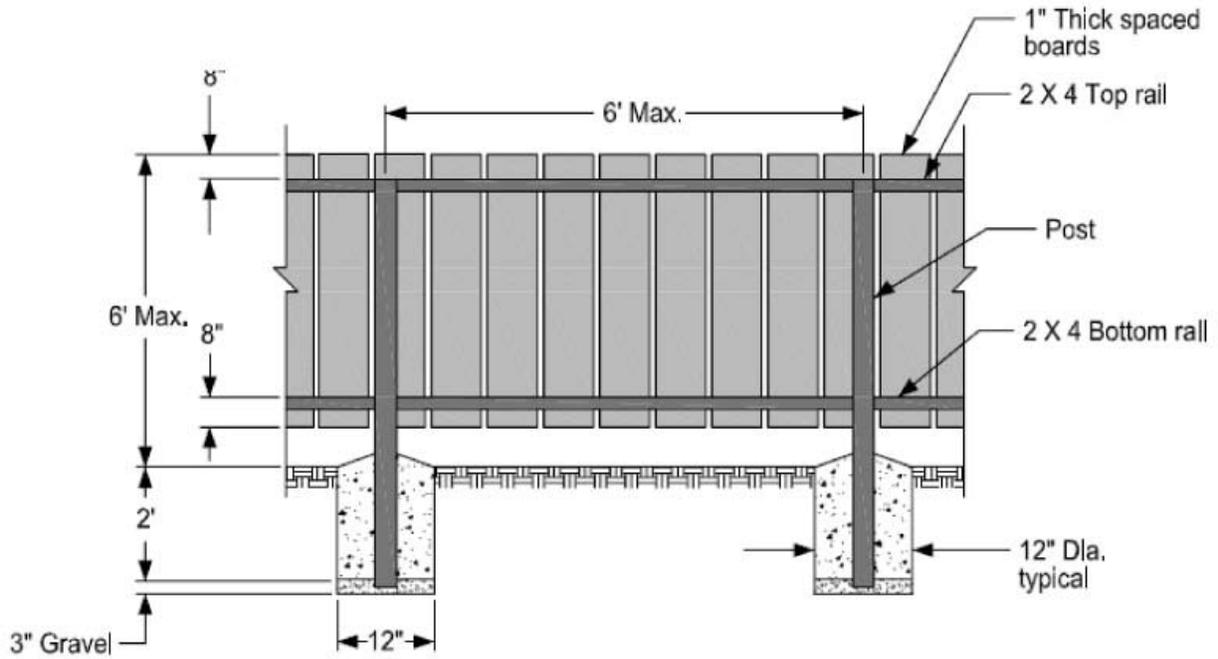
### 3.2 INSTALLATION OF FENCE

- A. Typical fence installation can be found in Figure 1 at the end of this specification section.

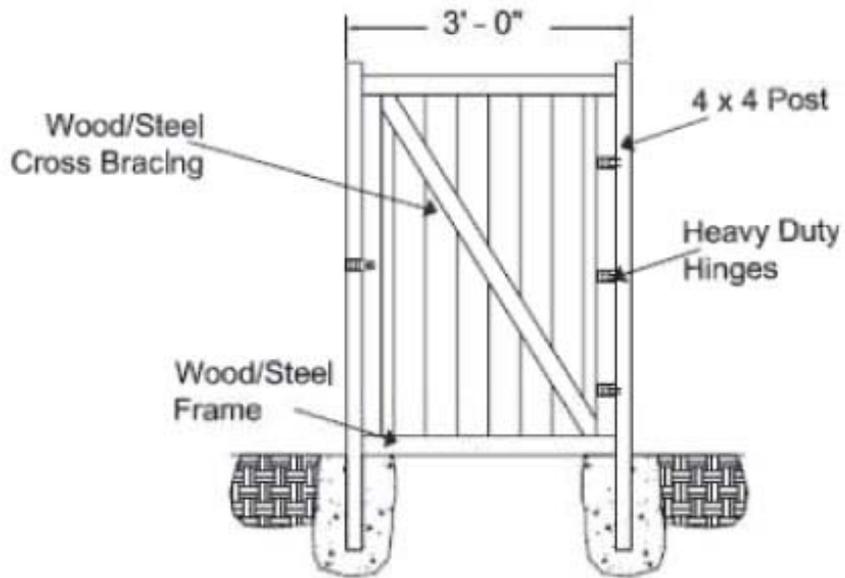
### 3.3 INSTALLATION OF GATES

- A. Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation.
- B. Man Gates:
  1. Once gate is installed coordinate on lock installation.
  2. Typical gate installation can be found in Figure 2 at the end of this specification section..
- C. Truck Gates:
  1. Shall open/close in direction as directed.

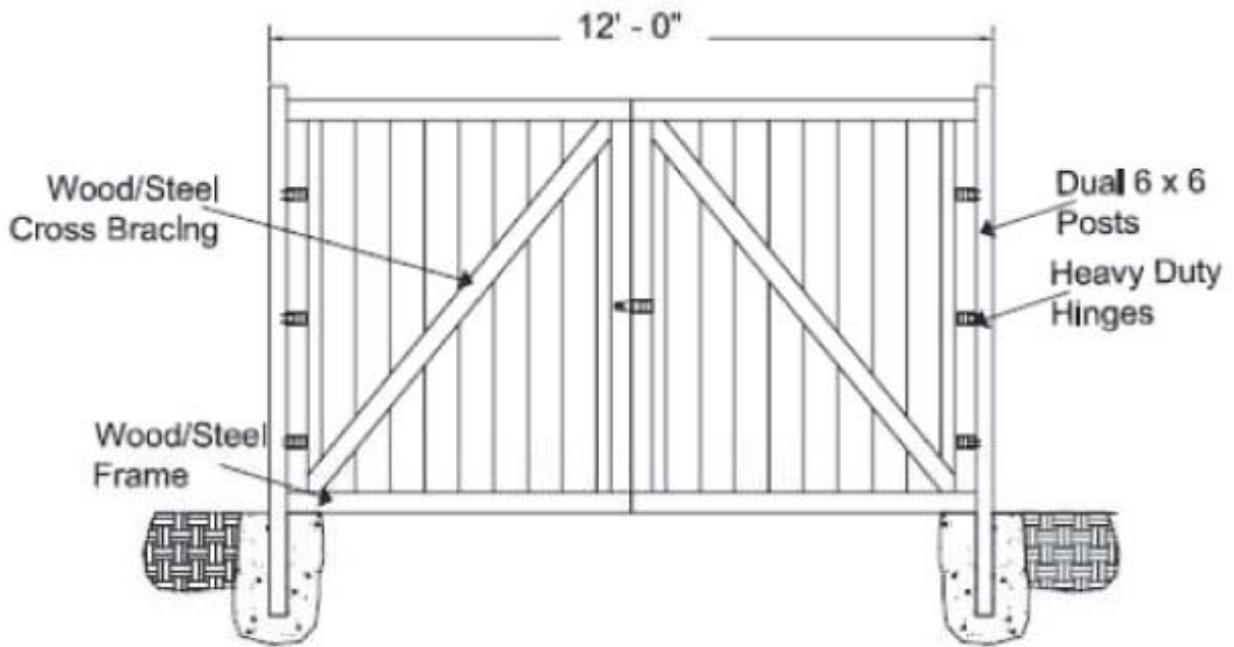
2. Once gate is installed coordinate on lock installation
3. Typical gate installation can be found in Figure 3 at the end of this specification section.



**FIGURE 1 Wood Fence Detail**



**FIGURE 2 - Wood Man Gate Detail**



**FIGURE 3 Wood Truck Gate Detail**

END OF SECTION 32 31 00

SECTION 329113 - SOIL  
PREPARATION

SECTION 329113 - SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes planting soils specified by composition of the mixes.
- B. Related Requirements:
  - 1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
  - 2. Section 329700 "Vegetated Roof Assemblies" for growing media (soil).

1.2 DEFINITIONS

- A. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- B. Imported Soil: Soil that is transported to Project site for use.
- C. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- E. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- F. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- G. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- H. USCC: U.S. Composting Council.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

SECTION 329113 - SOIL  
PREPARATION

1.4 INFORMATIONAL SUBMITTALS

1.5 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 MATERIALS

2.2 PLANTING SOILS SPECIFIED BY COMPOSITION

A. Planting-Soil Type : Imported, naturally formed soil from off-site sources and consisting of sandy loam soil according to USDA textures; and modified to produce viable planting soil.

1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches deep, not from agricultural land, bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and brome grass.
2. Additional Properties of Imported Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 4 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
3. Unacceptable Properties: Clean soil of the following:
  - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
  - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
  - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches in any dimension.

2.3 ORGANIC SOIL AMENDMENTS

A. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

SECTION 329113 - SOIL  
PREPARATION

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

3.2 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 8 inches . Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- C. Application: Spread planting soil to total depth indicated on Drawings , but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
  1. Lifts: Apply planting soil in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- D. Compaction: Compact each lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.3 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

- A. Application: Apply compost component of planting-soil mix 4 inches of compost to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

SECTION 329113 - SOIL  
PREPARATION

3.4 PROTECTION AND CLEANING

- A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."
- B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
  - 1. Storage of construction materials, debris, or excavated material.
  - 2. Parking vehicles or equipment.
  - 3. Vehicle traffic.
  - 4. Foot traffic.
  - 5. Erection of sheds or structures.
  - 6. Impoundment of water.
  - 7. Excavation or other digging unless otherwise indicated.
- C. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
  - 1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 329113

SECTION 329200 - TURF AND  
GRASSES

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Seeding.

1.2 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

PART 2 - PRODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. Quality, Non-State Certified: Seed of grass species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:

2.2 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

2.3 PESTICIDES

- A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as

SECTION 329200 - TURF AND  
GRASSES

required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 TURF AREA PREPARATION

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."
- B. Reduce elevation of planting soil to allow for soil thickness of sod.
- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.2 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
  - 1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
  - 2. Do not use wet seed or seed that is moldy or otherwise damaged.
  - 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 2 lb/1000 sq. ft. .
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas from hot, dry weather or drying winds by applying planting soil within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch , and roll surface smooth.

3.3 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
- B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings.

SECTION 329200 - TURF AND  
GRASSES

3.4 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches .
  2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

END OF SECTION 329200

## SECTION 329300 - PLANTS

### SECTION 329300 - PLANTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Fertilizers.
  - 2. Weed-control barriers.
  - 3. Mulches.
  - 4. Herbicides and pesticides.
  - 5. Tree-watering devices.

##### 1.2 PREINSTALLATION MEETINGS

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

##### 1.3 ACTION SUBMITTALS

- A. Product data.

##### 1.4 INFORMATIONAL SUBMITTALS

##### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

##### 1.6 QUALITY ASSURANCE

- A. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

##### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- B. Handle planting stock by root ball.

## SECTION 329300 - PLANTS

- C. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.
- D. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

### PART 2 - PRODUCTS

#### 2.1 PLANT MATERIALS

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
- B. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare in accordance with ANSI Z60.1.
- C. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery.

#### 2.2 FERTILIZERS

- A. Granular Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
  - 1. Composition:
    - a. 0.75 lb/1000 sq. ft. , 3 percent of actual nitrogen, 4 percent phosphorous, and 3 percent potassium, by weight.
    - b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

#### 2.3 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers inert to biological degradation and naturally resistant to chemicals, alkalis, and acids, formed into a stable network so that fibers retain their relative position.

## SECTION 329300 - PLANTS

### 2.4 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
  - 1. Type: Shredded hardwood .
  - 2. Size Range: 3 inches maximum, 1/2 inch minimum .
  - 3. Color: Natural.

### 2.5 HERBICIDES AND PESTICIDES

- A. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

### 2.6 TREE-STABILIZATION MATERIALS

- A. Trunk-Stabilization Materials:
  - 1. Wood Deadmen: Timbers measuring 8 inches in diameter and 48 inches long, treated with specified wood pressure-preservative treatment.
  - 2. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or turnbuckles .

### 2.7 TREE-WATERING DEVICES

- A. Slow-Release Watering Device: Standard product manufactured for drip irrigation of plants and emptying its water contents over an extended time period ; manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BIO-PLEX.
    - b. Engineered Watering Solutions; PQ Partners, LLC.
    - c. Spectrum Products, Inc.
  - 2. Color: green .

## PART 3 - EXECUTION

### 3.1 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil in accordance with Section 329113 "Soil Preparation."
- B. Placing Planting Soil: Place and mix planting soil in-place over exposed subgrade .
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

## SECTION 329300 - PLANTS

### 3.2 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits.
  - 1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
  - 2. Excavate approximately three times as wide as ball diameter for stock.
  - 3. Do not excavate deeper than depth of root ball, measured from the root flare to the bottom of root ball.

### 3.3 TREE, SHRUB, AND VINE PLANTING

- A. Inspection: At time of planting, verify that root flare is visible at top of root ball in accordance with ANSI Z60.1. If root flare is not visible, remove soil in a level manner from root ball to where the top-most root emerges from the trunk. After soil removal to expose root flare, verify that root ball still meets size requirements.
- B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
  - 1. Backfill: Planting soil . For trees, use excavated soil for backfill.
  - 2. Carefully remove root ball from container without damaging root ball or plant.
  - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  - 4. Distribute granular fertilizer around each planting pit when pit is approximately one-half filled. Do not place in bottom of the hole.
  - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of root ball.

### 3.4 INSTALLATION OF MULCHES

- A. Install weed-control barriers before mulching in accordance with manufacturer's written instructions. Completely cover area to be mulched, overlapping edges minimum of 6 inches , and secure seams with galvanized pins.
- B. Mulch backfilled surfaces of planting areas and other areas indicated.

## SECTION 329300 - PLANTS

1. Trees and Treelike Shrubs in Turf Areas: Apply organic mulch ring of 2-inch average thickness, with 12-inch radius around trunks or stems. Do not create a mulch cone or place mulch within 3 inches of trunks or stems.
2. Organic Mulch in Planting Areas: Apply 2-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting pit or trench , and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

### 3.5 INSTALLATION OF TREE-WATERING DEVICES

- A. Provide one device for each tree.

### 3.6 APPLICATION OF HERBICIDES AND PESTICIDES

- A. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written instructions. Do not apply to seeded areas.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written instructions.
- C. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and in accordance with manufacturer's written instructions. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

### 3.7 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

### 3.8 CLEANING AND PROTECTION

- A. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- B. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

SECTION 329300 - PLANTS

END OF SECTION 329300

# 1 Preservation Briefs

Technical Preservation Services

National Park Service  
U.S. Department of the Interior



## Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings

Robert C. Mack, FAIA  
Anne Grimmer

- » [Preparing for a Cleaning Project](#)
- » [Understanding the Building Materials](#)
- » [Cleaning Methods and Materials](#)
- » [Planning a Cleaning Project](#)
- » [Water-Repellent Coatings and Waterproof Coatings](#)
- » [Summary](#)



**A NOTE TO OUR USERS:** The web versions of the **Preservation Briefs** differ somewhat from the printed versions. Many illustrations are new, captions are simplified, illustrations are typically in color rather than black and white, and some complex charts have been omitted.

**Inappropriate cleaning and coating treatments are a major cause of damage** to historic masonry buildings. While either or both treatments may be appropriate in some cases, they can be very destructive to historic masonry if they are not selected carefully. Historic masonry, as considered here, includes stone, brick, architectural terra cotta, cast stone, concrete and concrete block. It is frequently cleaned because cleaning is equated with improvement. Cleaning may sometimes be followed by the application of a water-repellent coating. However, unless these procedures are carried out under the guidance and supervision of an architectural conservator, they may result in irrevocable damage to the historic resource.



Ninety years of accumulated dirt and pollutants are being removed from this historic theater using an appropriate chemical cleaner, applied in stages. Photo: Richard Wagner, AIA.

The purpose of this Brief is to provide information on the variety of cleaning methods and materials that are available for use on the *exterior* of historic masonry buildings, and to provide guidance in selecting the most appropriate method or combination of methods. The difference between water-repellent coatings and waterproof coatings is explained, and the purpose of each, the suitability of their application to historic masonry buildings, and the possible consequences of their inappropriate use are discussed.

The Brief is intended to help develop sensitivity to the qualities of historic masonry that makes it so special, and to assist historic building owners and property managers in working cooperatively with architects, architectural conservators, and contractors. Although specifically intended for historic buildings, the information is applicable

to all masonry buildings. This publication updates and expands *Preservation Briefs 1: The Cleaning and Waterproof Coating of Masonry Buildings*. The Brief is not meant to be a cleaning manual or a guide for preparing specifications. Rather, it provides general information to raise awareness of the many factors involved in selecting cleaning and water-repellent treatments for historic masonry buildings.

---

## Preparing for a Cleaning Project

**Reasons for cleaning.** First, it is important to determine whether it is appropriate to clean the masonry. The objective of cleaning a historic masonry building must be considered carefully before arriving at a decision to clean. There are several major reasons for cleaning a historic masonry building: **improve the appearance of the building** by removing unattractive dirt or soiling materials, or non-historic paint from the masonry; **retard deterioration** by removing soiling materials that may be damaging the masonry; or **provide a clean surface** to accurately match repointing mortars or patching compounds, or to conduct a condition survey of the masonry.

**Identify what is to be removed.** The general nature and source of dirt or soiling material on a building must be identified to remove it in the gentlest means possible-- that is, in the most effective, yet least harmful, manner. Soot and smoke, for example, require a different cleaning agent to remove than oil stains or metallic stains. Other common cleaning problems include biological growth such as mold or mildew, and organic matter such as the tendrils left on masonry after removal of ivy.

**Consider the historic appearance of the building.** If the proposed cleaning is to remove paint, it is important in each case to learn whether or not unpainted masonry is historically appropriate. And, it is necessary to consider why the building was painted. Was it to cover bad repointing or unmatched repairs? Was the building painted to protect soft brick or to conceal deteriorating stone? Or, was painted masonry simply a fashionable treatment in a particular historic period? Many buildings were painted at the time of construction or shortly thereafter; retention of the paint, therefore, may be more appropriate historically than removing it. And, if the building appears to have been painted for a long time, it is also important to think about whether the paint is part of the character of the historic building and if it has acquired significance over time.

**Consider the practicalities of cleaning or paint removal.** Some gypsum or sulfate crusts may have become integral with the stone and, if cleaning could result in removing some of the stone surface, it may be preferable not to clean. Even where unpainted

masonry is appropriate, the retention of the paint may be more practical than removal in terms of long range preservation of the masonry. In some cases, however, removal of the paint may be desirable. For example, the old paint layers may have built up to such an extent that removal is necessary to ensure a sound surface to which the new paint will adhere.

**Study the masonry.** Although not always necessary, in some instances it can be beneficial to have the coating or paint type, color, and layering on the masonry researched before attempting its removal. Analysis of the nature of the soiling or of the paint to be removed from the masonry, as well as guidance on the appropriate cleaning method, may be provided by professional consultants, including architectural conservators, conservation scientists, and preservation architects. The State Historic Preservation Office (SHPO), local historic district commissions, architectural review boards, and preservation-oriented websites may also be able to supply useful information on masonry cleaning techniques.

---

## Understanding the Building Materials

The construction of the building must be considered when developing a cleaning program because inappropriate cleaning can have a deleterious effect on the masonry as well as on other building materials. The masonry material or materials must be correctly identified. It is sometimes difficult to distinguish one type of stone from another; for example, certain sandstones can be easily confused with limestones. Or, what appears to be natural stone may not be stone at all, but cast stone or concrete. Historically, cast stone and architectural terra cotta were frequently used in combination with natural stone, especially for trim elements or on upper stories of a building where, from a distance, these substitute materials looked like real stone. Other features on historic buildings that appear to be stone, such as decorative cornices, entablatures and window hoods, may not even be masonry, but metal.

**Identify prior treatments.** Previous treatments of the building and its surroundings should be researched and building maintenance records should be obtained, if available.

Sometimes if streaked or spotty areas do not seem to get cleaner following an initial cleaning, closer inspection and analysis may be warranted. The discoloration may turn out not to be dirt but the remnant of a water-repellent coating applied long ago which has darkened the surface of the masonry over time. Successful removal may require testing several cleaning agents to find something that will dissolve and remove the coating. Complete removal may not always be possible. Repairs may have been stained to match a dirty building, and cleaning may make these differences apparent. De-icing salts used near the building that have dissolved can migrate into the masonry. Cleaning may draw the salts to the surface, where they will appear as efflorescence (a powdery, white substance), which may require a second treatment to be removed. Allowances for dealing with such unknown factors, any of which can be a potential problem, should be included when investigating cleaning methods and materials. Just as more than one kind of masonry on a historic building may necessitate multiple cleaning approaches, unknown conditions that are encountered may also require additional cleaning treatments.



The decorative trim on this brick building is architectural terra-cotta intended to simulate the limestone foundation. Photo: NPS files.



Any cleaning method should be tested before using it on historic masonry. Photo: NPS files.

**Choose the appropriate cleaner.** The importance of testing cleaning methods and materials cannot be over emphasized. Applying the wrong cleaning agents to historic masonry can have disastrous results. Acidic cleaners can be extremely damaging to acid-sensitive stones, such as marble and limestone, resulting in etching and dissolution of these stones. Other kinds of masonry can also be damaged by incompatible cleaning agents, or even by cleaning agents that are usually compatible. There are also numerous kinds of sandstone, each with a considerably different geological composition. While an acid-based cleaner may be safely used on some sandstones, others are acid-sensitive and can be severely etched or dissolved by an acid cleaner. Some sandstones contain water-soluble minerals and

can be eroded by water cleaning. And, even if the stone type is correctly identified, stones, as well as some bricks, may contain unexpected impurities, such as iron particles, that may react negatively with a particular cleaning agent and result in staining. Thorough understanding of the physical and chemical properties of the masonry will help avoid the inadvertent selection of damaging cleaning agents. Other building materials also may be affected by the cleaning process. Some chemicals, for example, may have a corrosive effect on paint or glass. The portions of building elements most vulnerable to deterioration may not be visible, such as embedded ends of iron window bars. Other totally unseen items, such as iron cramps or ties which hold the masonry to the structural frame, also may be subject to corrosion from the use of chemicals or even from plain water. The only way to prevent problems in these cases is to study the building construction in detail and evaluate proposed cleaning methods with this information in mind. However, due to the very likely possibility of encountering unknown factors, any cleaning project involving historic masonry should be viewed as unique to that particular building.

---

## Cleaning Methods and Materials

Masonry cleaning methods generally are divided into three major groups: water, chemical, and abrasive. *Water methods* soften the dirt or soiling material and rinse the deposits from the masonry surface. *Chemical cleaners* react with dirt, soiling material or paint to effect their removal, after which the cleaning effluent is rinsed off the masonry surface with water. *Abrasive methods* include blasting with grit, and the use of grinders and sanding discs, all of which mechanically remove the dirt, soiling material or paint (and, usually, some of the masonry surface). Abrasive cleaning is also often followed with a water rinse. *Laser cleaning*, although not discussed here in detail, is another technique that is used sometimes by conservators to clean small areas of historic masonry. It can be quite effective for cleaning limited areas, but it is expensive and generally not practical for most historic masonry cleaning projects.

Although it may seem contrary to common sense, masonry cleaning projects should be carried out starting at the bottom and proceeding to the top of the building always keeping all surfaces wet below the area being cleaned. The rationale for this approach is based on the principle that dirty water or cleaning effluent dripping from cleaning in progress above will leave streaks on a dirty surface but will not streak a clean surface as long as it is kept wet and rinsed frequently.

## Water Cleaning

Water cleaning methods are generally the *gentlest means possible*, and they can be used safely to remove dirt from all types of historic masonry.\* There are essentially four kinds of water-based methods: soaking; pressure water washing; water washing supplemented with non-ionic detergent; and steam, or hot-pressurized water cleaning. Once water cleaning has been completed, it is often necessary to follow up with a water rinse to wash off the loosened soiling material from the masonry.

---

\* Water cleaning methods may not be appropriate to use on some badly deteriorated masonry because water may exacerbate the deterioration, or on gypsum or alabaster, which are very soluble in water.

**Soaking.** Prolonged spraying or misting with water is particularly effective for cleaning limestone and marble. It is also a good method for removing heavy accumulations of soot, sulfate crusts or gypsum crusts that tend to form in protected areas of a building not regularly washed by rain. Water is distributed to lengths of punctured hose or pipe with non-ferrous fittings hung from moveable scaffolding or a swing stage that continuously mists the surface of the masonry with a very fine spray. A timed on-off spray is another approach to using this cleaning technique. After one area has been cleaned, the apparatus is moved on to another. Soaking is often used in combination with water washing and is also followed by a final water rinse. Soaking is a very slow method--it may take several days or a week--but it is a very gentle method to use on historic masonry.

**Water Washing.** Washing with low-pressure or medium-pressure water is probably one of the most commonly used methods for removing dirt or other pollutant soiling from historic masonry buildings. Starting with a very low pressure (100 psi or below), even using a garden hose, and progressing as needed to slightly higher pressure--generally no higher than 300-400 psi--is always the recommended way to begin. Scrubbing with natural bristle or synthetic bristle brushes--never metal which can abrade the surface and leave metal particles that can stain the masonry--can help in cleaning areas of the masonry that are especially dirty.

**Water Washing with Detergents.** Non-ionic detergents--which are not the same as soaps--are synthetic organic compounds that are especially effective in removing oily soil. (Examples of some of the numerous proprietary non-ionic detergents include Igepal by GAF, Tergitol by Union Carbide and Triton by Rohm & Haas.) Thus, the addition of a non-ionic detergent, or surfactant, to a low- or medium-pressure water wash can be a useful aid in the cleaning process. (A non-ionic detergent, unlike most household detergents, does not leave a solid, visible residue on the masonry.) Adding a non-ionic detergent and scrubbing with a natural bristle or synthetic bristle brush can facilitate cleaning textured or intricately carved masonry. This should be followed with a final water rinse.

**Steam/Hot-Pressurized Water Cleaning.** Steam cleaning is actually low-pressure hot water washing because the steam condenses almost immediately upon leaving the hose. This is a gentle and effective method for cleaning stone and particularly for acid-sensitive stones. Steam can be especially useful in removing built-up soiling deposits



Low-to-medium-pressure steam (hot-pressurized water washing) is a gentle method of softening heavy soiling deposits and cleaning historic marble. Photo: NPS files.

and dried-up plant materials, such as ivy disks and tendrils. It can also be an efficient means of cleaning carved stone details and, because it does not generate a lot of liquid water, it can sometimes be appropriate to use for cleaning interior masonry.

**Potential hazards of water cleaning.** Despite the fact that water-based methods are generally the most gentle, even they can be damaging to historic masonry. Before beginning a water cleaning project, it is important to make sure that all mortar joints are sound and that the building is watertight. Otherwise water can seep through the walls to the interior, resulting in rusting metal anchors and stained and ruined plaster.

Some water supplies may contain traces of iron and copper which may cause masonry to discolor. Adding a chelating or complexing agent to the water, such as EDTA (ethylene diamine tetra-acetic acid), which inactivates other metallic ions, as well as softens minerals and water hardness, will help prevent staining on light-colored masonry.

Any cleaning method involving water should never be done in cold weather or if there is any likelihood of frost or freezing because water within the masonry can freeze, causing spalling and cracking. Since a masonry wall may take over a week to dry after cleaning, no water cleaning should be permitted for several days prior to the first average frost date, or even earlier if local forecasts predict cold weather.

Most important of all, it is imperative to be aware that using water at too high a pressure, a practice common to "power washing" and "water blasting", is very abrasive and can easily etch marble and other soft stones, as well as some types of brick. In addition, the distance of the nozzle from the masonry surface and the type of nozzle, as well as gallons per minute (gpm), are also important variables in a water cleaning process that can have a significant impact on the outcome of the project. This is why it is imperative that the cleaning be closely monitored to ensure that the cleaning operators do not raise the pressure or bring the nozzle too close to the masonry in an effort to "speed up" the process. The appearance of grains of stone or sand in the cleaning effluent on the ground is an indication that the water pressure may be too high.

## Chemical Cleaning

Chemical cleaners, generally in the form of proprietary products, are another material frequently used to clean historic masonry. They can remove dirt, as well as paint and other coatings, metallic and plant stains, and graffiti. Chemical cleaners used to remove dirt and soiling include **acids**, **alkalies** and **organic compounds**. Acidic cleaners, of course, should not be used on masonry that is acid sensitive. Paint removers are **alkaline**, based on **organic solvents** or other chemicals.

## Chemical Cleaners to Remove Dirt

Both alkaline and acidic cleaning treatments include the use of water. Both cleaners are also likely to contain surfactants (wetting agents), that facilitate the chemical reaction that removes the dirt. Generally, the masonry is wet first for both types of cleaners, then the chemical cleaner is sprayed on at very low pressure or brushed onto the surface. The cleaner is left to dwell on the masonry for an amount of time recommended by the product manufacturer or, preferably, determined by testing, and rinsed off with a low- or moderate-pressure cold, or sometimes hot, water wash.

More than one application of the cleaner may be necessary, and it is always a good practice to test the product manufacturer's recommendations concerning dilution rates and dwell times. Because each cleaning situation is unique, dilution rates and dwell times can vary considerably. The masonry surface may be scrubbed lightly with natural or synthetic bristle brushes prior to rinsing. After rinsing, pH strips should be applied to the surface to ensure that the masonry has been neutralized completely.

**Acidic Cleaners.** Acid-based cleaning products may be used on **non-acid sensitive masonry**, which generally includes: granite, most sandstones, slate, unglazed brick and unglazed architectural terra cotta, cast stone and concrete. Most commercial acidic cleaners are composed primarily of hydrofluoric acid, and often include some phosphoric acid to prevent rust-like stains from developing on the masonry after the cleaning. Acid cleaners are applied to the pre-wet masonry which should be kept wet while the acid is allowed to "work", and then removed with a water wash.

**Alkaline Cleaners.** Alkaline cleaners should be used on **acid-sensitive** masonry, including: limestone, polished and unpolished marble, calcareous sandstone, glazed brick and glazed architectural terra cotta, and polished granite. (Alkaline cleaners may also be used sometimes on masonry materials that are not acid sensitive--after testing, of course--but they may not be as effective as they are on acid-sensitive masonry.) Alkaline cleaning products consist primarily of two ingredients: a non-ionic detergent or surfactant; and an alkali, such as potassium hydroxide or ammonium hydroxide. Like acidic cleaners, alkaline products are usually applied to pre-wet masonry, allowed to dwell, and then rinsed off with water. (Longer dwell times may be necessary with alkaline cleaners than with acidic cleaners.) Two additional steps are required to remove alkaline cleaners after the initial rinse. First the masonry is given a slightly acidic wash--often with acetic acid--to neutralize it, and then it is rinsed again with water.

## **Chemical Cleaners to Remove Paint and Other Coatings, Stains and Graffiti**

Removing paint and some other coatings, stains and graffiti can best be accomplished with alkaline paint removers, organic solvent paint removers, or other cleaning compounds. The removal of layers of paint from a masonry surface usually involves applying the remover either by brush, roller or spraying, followed by a thorough water wash. As with any chemical cleaning, the manufacturer's recommendations regarding application procedures should always be tested before beginning work.

**Alkaline Paint Removers.** These are usually of much the same composition as other alkaline cleaners, containing potassium or ammonium hydroxide, or trisodium phosphate. They are used to remove oil, latex and acrylic paints, and are effective for removing multiple layers of paint. Alkaline cleaners may also remove some acrylic water-repellent coatings. As with other alkaline cleaners, both an acidic neutralizing wash and a final water rinse are generally required following the use of alkaline paint removers.

**Organic Solvent Paint Removers.** The formulation of organic solvent paint removers varies and may include a combination of solvents, including methylene chloride, methanol, acetone, xylene and toluene.

**Other Paint Removers and Cleaners.** Other cleaning compounds that can be used to remove paint and some painted graffiti from historic masonry include paint removers based on N-methyl-2-pyrrolidone (NMP), or on petroleum-based compounds. Removing stains, whether they are industrial (smoke, soot, grease or tar), metallic (iron or copper), or biological (plant and fungal) in origin, depends on carefully matching the type of remover to the type of stain. Successful removal of stains from historic masonry often requires the application of a number of different removers before the right one is found. The removal of layers of paint from a masonry surface is usually accomplished by applying the remover either by brush, roller or spraying, followed by a thorough water wash.

**Potential hazards of chemical cleaning.** Since most chemical cleaning methods involve water, they have many of the potential problems of plain water cleaning. Like water methods, they should not be used in cold weather because of the possibility of

freezing. Chemical cleaning should never be undertaken in temperatures below 40 degrees F (4 degrees C), and generally not below 50 degrees F. In addition, many chemical cleaners simply do not work in cold temperatures. Both acidic and alkaline cleaners can be dangerous to cleaning operators, and clearly, there are environmental concerns associated with the use of chemical cleaners.

If not carefully chosen, chemical cleaners can react adversely with many types of masonry. Obviously, acidic cleaners should not be used on acid-sensitive materials; however, it is not always clear exactly what the composition is of any stone or other masonry material. For, this reason, testing the cleaner on an inconspicuous spot on the building is always necessary. While certain acid-based cleaners may be appropriate if used as directed on a particular type of masonry, if left too long or if not adequately rinsed from the masonry they can have a negative effect. For example, hydrofluoric acid can etch masonry leaving a hazy residue (whitish deposits of silica or calcium fluoride salts) on the surface. While this efflorescence may usually be removed by a second cleaning--although it is likely to be expensive and time-consuming--**hydrofluoric acid** can also leave calcium fluoride salts or a colloidal silica deposit on masonry which may be impossible to remove. Other acids, particularly **hydrochloric (muriatic) acid**, which is very powerful, should not be used on historic masonry, because it can dissolve lime-based mortar, damage brick and some stones, and leave chloride deposits on the masonry.

Alkaline cleaners can stain sandstones that contain a ferrous compound. Before using an alkaline cleaner on sandstone it is always important to test it, since it may be difficult to know whether a particular sandstone may contain a ferrous compound. Some alkaline cleaners, such as **sodium hydroxide (caustic soda or lye)** and **ammonium bifluoride**, can also damage or leave disfiguring brownish-yellow stains and, in most cases, should not be used on historic masonry. Although alkaline cleaners will not etch a masonry surface as acids can, they are caustic and can burn the surface. In addition, alkaline cleaners can deposit potentially damaging salts in the masonry which can be difficult to rinse thoroughly.

## Poulticing to Remove Stains and Graffiti

Graffiti and stains, which have penetrated into the masonry, often are best removed by using a poultice. A poultice consists of an absorbent material or clay powder (such as kaolin or fuller's earth, or even shredded paper or paper towels), mixed with a liquid (a solvent or other remover) to form a paste which is applied to the stain. The poultice is kept moist and left on the stain as long as necessary for it to draw the stain out of the masonry. As it dries, the paste absorbs the staining material so that it is not redeposited on the masonry surface.



The iron stain on this granite post may

be removed by applying a commercial rust-removal product in a poultice.  
Photo: NPS files

Some commercial cleaning products and paint removers are specially formulated as a paste or gel that will cling to a vertical surface and remain moist for a longer period of time in order to prolong the action of the chemical on the stain. Pre-mixed poultices are also available as a paste or in powder form needing only the addition of the appropriate liquid. The masonry must be pre-wet before applying an alkaline cleaning agent, but not when using a solvent. Once the stain has been removed, the masonry must be rinsed thoroughly.

## Abrasive and Mechanical Cleaning

**Generally, abrasive cleaning methods are not appropriate for use on historic masonry buildings.** Abrasive cleaning methods are just that--abrasive. Grit blasters, grinders, and sanding discs all operate by abrading the dirt or paint off the surface of the masonry, rather than reacting with the dirt and the masonry which is how water and chemical methods work. Since the abrasives do not differentiate between the dirt and the masonry, they can also remove the outer surface of the masonry at the same time, and result in permanently damaging the masonry. Brick, architectural terra cotta, soft stone, detailed carvings, and polished surfaces, are especially susceptible to physical and aesthetic damage by abrasive methods. Brick and architectural terra cotta are fired products which have a smooth, glazed surface which can be removed by abrasive blasting or grinding. Abrasively-cleaned masonry is damaged aesthetically as well as physically, and it has a rough surface which tends to hold dirt and the roughness will make future cleaning more difficult. Abrasive cleaning processes can also increase the likelihood of subsurface cracking of the masonry. Abrasion of carved details causes a rounding of sharp corners and other loss of delicate features, while abrasion of polished surfaces removes the polished finish of stone.

Mortar joints, especially those with lime mortar, also can be eroded by abrasive or mechanical cleaning. In some cases, the damage may be visual, such as loss of joint detail or increased joint shadows. As mortar joints constitute a significant portion of the masonry surface (up to 20 per cent in a brick wall), this can result in the loss of a considerable amount of the historic fabric. Erosion of the mortar joints may also permit increased water penetration, which will likely necessitate repointing.

**Abrasive Blasting.** Blasting with abrasive grit or another abrasive material is the most frequently used abrasive method. Sandblasting is most commonly associated with abrasive cleaning. Finely ground silica or glass powder, glass beads, ground garnet, powdered walnut and other ground nut shells, grain hulls, aluminum oxide, plastic particles and even tiny pieces of sponge, are just a few of the other materials that have also been used for abrasive cleaning. Although abrasive blasting is not an appropriate method of cleaning historic masonry, it can be safely used to clean some



Sandblasting has permanently damaged this brick wall. Photo: NPS files

materials. Finely-powdered walnut shells are commonly used for cleaning monumental bronze sculpture, and skilled conservators clean delicate museum objects and finely detailed, carved stone features with very small, micro-abrasive units using aluminum oxide.

A number of current approaches to abrasive blasting rely on materials that are not usually thought of as abrasive, and not as commonly associated with traditional abrasive grit cleaning. Some patented abrasive cleaning processes--one dry, one wet--use finely-ground glass powder intended to "erase" or remove dirt and surface soiling only, but not paint or stains. Cleaning with baking soda (sodium bicarbonate) is another patented process. Baking soda blasting is being used in some communities as a means of quick graffiti removal. However, it should not be used on historic masonry which it can easily abrade and can permanently "etch" the graffiti into the stone; it can also leave potentially damaging salts in the stone which cannot be removed. Most of these abrasive grits may be used either dry or wet, although dry grit tends to be used more frequently. Ice particles, or pelletized dry ice (carbon dioxide or CO<sub>2</sub>), are another medium used as an abrasive cleaner. This is also too abrasive to be used on most historic masonry, but it may have practical application for removing mastics or asphaltic coatings from some substrates.

Some of these processes are promoted as being more environmentally safe and not damaging to historic masonry buildings. However, it must be remembered that they are abrasive and that they "clean" by removing a small portion of the masonry surface, even though it may be only a minuscule portion. The fact that they are essentially abrasive treatments must always be taken into consideration when planning a masonry cleaning project. In general, abrasive methods should not be used to clean historic masonry buildings. In some, very limited instances, highly-controlled, gentle abrasive cleaning may be appropriate on selected, hard-to-clean areas of a historic masonry building if carried out under the watchful supervision of a professional conservator. But, abrasive cleaning should never be used on an entire building.

**Grinders and Sanding Disks.** Grinding the masonry surface with mechanical grinders and sanding disks is another means of abrasive cleaning that should not be used on historic masonry. Like abrasive blasting, grinders and disks do not really clean masonry but instead grind away and abrasively remove and, thus, damage the masonry surface itself rather than remove just the soiling material.

---

## Planning a Cleaning Project

Once the masonry and soiling material or paint have been identified, and the condition of the masonry has been evaluated, planning for the cleaning project can begin.

**Testing cleaning methods.** In order to determine the *gentlest means possible*, several cleaning methods or materials may have to be tested prior to selecting the best one to use on the building. Testing should always begin with the gentlest and least invasive method proceeding gradually, if necessary, to more complicated methods, or a combination of methods. All too often simple methods, such as a low-pressure water wash, are not even considered, yet they frequently are effective, safe, and not expensive. Water of slightly higher pressure or with a non-ionic detergent additive also may be effective. It is worth repeating that these methods should always be tested prior to considering harsher methods; they are safer for the building and the environment, often safer for the applicator, and relatively inexpensive.

The level of cleanliness desired also should be determined prior to selection of a cleaning method. Obviously, the intent of cleaning is to remove most of the dirt, soiling material, stains, paint or other coating. A "brand new" appearance, however, may be

inappropriate for an older building, and may require an overly harsh cleaning method to be achieved. When undertaking a cleaning project, it is important to be aware that some stains simply may not be removable. It may be wise, therefore, to agree upon a slightly lower level of cleanliness that will serve as the standard for the cleaning project. The precise amount of residual dirt considered acceptable may depend on the type of masonry, the type of soiling and difficulty of total removal, and local environmental conditions.

Cleaning tests should be carried out in an area of sufficient size to give a true indication of their effectiveness. It is preferable to conduct the test in an inconspicuous location on the building so that it will not be obvious if the test is not successful. A test area may be quite small to begin, sometimes as small as six square inches, and gradually may be increased in size as the most appropriate methods and cleaning agents are determined. Eventually the test area may be expanded to a square yard or more, and it should include several masonry units and mortar joints. It should be remembered that a single building may have several types of masonry and that even similar materials may have different surface finishes. Each material and different finish should be tested separately. Cleaning tests should be evaluated only after the masonry has dried completely. *The results of the tests may indicate that several methods of cleaning should be used on a single building.*

When feasible, test areas should be allowed to weather for an extended period of time prior to final evaluation. A waiting period of a full year would be ideal in order to expose the test patch to a full range of seasons. If this is not possible, the test patch should weather for at least a month or two. For any building which is considered historically important, the delay is insignificant compared to the potential damage and disfigurement which may result from using an incompletely tested method. *The successfully cleaned test patch should be protected as it will serve as a standard against which the entire cleaning project will be measured.*

**Environmental considerations.** The potential effect of any method proposed for cleaning historic masonry should be evaluated carefully. Chemical cleaners and paint removers may damage trees, shrubs, grass, and plants. A plan must be provided for environmentally safe removal and disposal of the cleaning materials and the rinsing effluent before beginning the cleaning project. Authorities from the local regulatory agency--usually under the jurisdiction of the federal or state Environmental Protection Agency (EPA)--should be consulted prior to beginning a cleaning project, especially if it involves anything more than plain water washing. This advance planning will ensure that the cleaning effluent or run-off, which is the combination of the cleaning agent and the substance removed from the masonry, is handled and disposed of in an environmentally sound and legal manner. Some alkaline and acidic cleaners can be neutralized so that they can be safely discharged into storm sewers. However, most solvent-based cleaners cannot be neutralized and are categorized as pollutants, and must be disposed of by a licensed transport, storage and disposal facility. Thus, it is always advisable to consult with the appropriate agencies before starting to clean to ensure that the project progresses smoothly and is not interrupted by a stop-work order because a required permit was not obtained in advance.

Vinyl guttering or polyethylene-lined troughs placed around the perimeter of the base of the building can serve to catch chemical cleaning waste as it is rinsed off the building. This will reduce the amount of chemicals entering and polluting the soil, and also will keep the cleaning waste contained until it can be removed safely. Some patented cleaning systems have developed special equipment to facilitate the containment and later disposal of cleaning waste.

Concern over the release of volatile organic compounds (VOCs) into the air has resulted in the manufacture of new, more environmentally responsible cleaners and paint removers, while some materials traditionally used in cleaning may no longer be available

for these same reasons. Other health and safety concerns have created additional cleaning challenges, such as lead paint removal, which is likely to require special removal and disposal techniques.

Cleaning can also cause damage to non-masonry materials on a building, including glass, metal and wood. Thus, it is usually necessary to cover windows and doors, and other features that may be vulnerable to chemical cleaners. They should be covered with plastic or polyethylene, or a masking agent that is applied as a liquid which dries to form a thin protective film on glass, and is easily peeled off after the cleaning is finished. Wind drift, for example, can also damage other property by carrying cleaning chemicals onto nearby automobiles, resulting in etching of the glass or spotting of the paint finish. Similarly, airborne dust can enter surrounding buildings, and excess water can collect in nearby yards and basements.

**Safety considerations.** Possible health dangers of each method selected for the cleaning project must be considered before selecting a cleaning method to avoid harm to the cleaning applicators, and the necessary precautions must be taken. The precautions listed in Material Safety Data Sheets (MSDS) that are provided with chemical products should always be followed. Protective clothing, respirators, hearing and face shields, and gloves must be provided to workers to be worn at all times. Acidic and alkaline chemical cleaners in both liquid and vapor forms can also cause serious injury to passers-by. It may be necessary to schedule cleaning at night or weekends if the building is located in a busy urban area to reduce the potential danger of chemical overspray to pedestrians. Cleaning during non-business hours will allow HVAC systems to be turned off and vents to be covered to prevent dangerous chemical fumes from entering the building which will also ensure the safety of the building's occupants. Abrasive and mechanical methods produce dust which can pose a serious health hazard, particularly if the abrasive or the masonry contains silica.



The lower floors of this historic brick and architectural terra-cotta building have been covered during chemical cleaning to protect pedestrians and vehicular traffic from potentially harmful overspray. Photo: NPS files.

---

## Water-Repellent Coatings and Waterproof Coatings

To begin with, it is important to understand that waterproof coatings and water-repellent coatings are not the same. Although these terms are frequently interchanged and commonly confused with one another, they are completely different materials. **Water-repellent coatings**--often referred to incorrectly as "sealers", but which do not or should not "seal"--are intended to keep liquid water from penetrating the surface but to allow water vapor to enter and leave, or pass through, the surface of the masonry. Water-repellent coatings are generally transparent, or clear, although once applied some may darken or discolor certain types of masonry while others may give it a glossy or shiny appearance. **Waterproof coatings** seal the surface from liquid water and from water vapor. They are usually opaque, or pigmented, and include bituminous coatings and some elastomeric paints and coatings.

### Water-Repellent Coatings

Water-repellent coatings are formulated to be vapor permeable, or "breathable". They

do not seal the surface completely to water vapor so it can enter the masonry wall as well as leave the wall. While the first water-repellent coatings to be developed were primarily acrylic or silicone resins in organic solvents, now most water-repellent coatings are water-based and formulated from modified siloxanes, silanes and other alkoxysilanes, or metallic stearates. While some of these products are shipped from the factory ready to use, other water-borne water repellents must be diluted at the job site. Unlike earlier water-repellent coatings which tended to form a "film" on the masonry surface, modern water-repellent coatings actually penetrate into the masonry substrate slightly and, generally, are almost invisible if properly applied to the masonry. They are also more vapor permeable than the old coatings, yet they still reduce the vapor permeability of the masonry. Once inside the wall, water vapor can condense at cold spots producing liquid water which, unlike water vapor, cannot escape through a water-repellent coating. The liquid water within the wall, whether from condensation, leaking gutters, or other sources, can cause considerable damage.



This clear coating has failed and is pulling off pieces of the stone as it peels. Photo: NPS files

Water-repellent coatings are not consolidants. Although modern water-repellents may penetrate slightly beneath the masonry surface, instead of just "sitting" on top of it, they do not perform the same function as a consolidant which is to "consolidate" and replace lost binder to strengthen deteriorating masonry. Even after many years of laboratory study and testing, few consolidants have proven very effective. The composition of fired products such as brick and architectural terra cotta, as well as many types of building stone, does not lend itself to consolidation.

Some modern water-repellent coatings which contain a binder intended to replace the natural binders in stone that have been lost through weathering and natural erosion are described in product literature as both a water repellent and a consolidant. The fact that the newer water-repellent coatings penetrate beneath the masonry surface instead of just forming a layer on top of the surface may indeed convey at least some consolidating properties to certain stones. However, a water-repellent coating cannot be considered a consolidant. In some instances, a water-repellent or "preservative" coating, if applied to already damaged or spalling stone, may form a surface crust which, if it fails, may exacerbate the deterioration by pulling off even more of the stone.

## Is a Water-Repellent Treatment Necessary?

Water-repellent coatings are frequently applied to historic masonry buildings for the wrong reason. They also are often applied without an understanding of what they are and what they are intended to do. And these coatings can be very difficult, if not impossible, to remove from the masonry if they fail or become discolored. Most importantly, the application of water-repellent coatings to historic masonry is usually unnecessary.

Most historic masonry buildings, unless they are painted, have survived for decades without a water-repellent coating and, thus, probably do not need one now. Water penetration to the interior of a masonry building is seldom due to porous masonry, but results from poor or deferred maintenance. Leaking roofs, clogged or deteriorated gutters and downspouts, missing mortar, or cracks and open joints around door and window openings are almost always the cause of moisture-related problems in a historic masonry building. **If historic masonry buildings are kept watertight and in good repair, water-repellent coatings should not be necessary.**

Rising damp (capillary moisture pulled up from the ground), or condensation can also be a source of excess moisture in masonry buildings. A water-repellent coating will not solve this problem either and, in fact, may be likely to exacerbate it. Furthermore, a water-repellent coating should never be applied to a damp wall. Moisture in the wall would reduce the ability of a coating to adhere to the masonry and to penetrate below the surface. But, if it did adhere, it would hold the moisture inside the masonry because, although a water-repellent coating is permeable to water vapor, liquid water cannot pass through it. In the case of rising damp, a coating may force the moisture to go even higher in the wall because it can slow down evaporation, and thereby retain the moisture in the wall.

Excessive moisture in masonry walls may carry waterborne soluble salts from the masonry units themselves or from the mortar through the walls. If the water is permitted to come to the surface, the salts may appear on the masonry surface as efflorescence (a whitish powder) upon evaporation. However, the salts can be potentially dangerous if they remain in the masonry and crystallize beneath the surface as subflorescence. Subflorescence eventually may cause the surface of the masonry to spall, particularly if a water-repellent coating has been applied which tends to reduce the flow of moisture out from the subsurface of the masonry. Although many of the newer water-repellent products are more breathable than their predecessors, they can be especially damaging if applied to masonry that contains salts, because they limit the flow of moisture through masonry.

## When a Water-Repellent Coating May be Appropriate

There are some instances when a water-repellent coating may be considered appropriate to use on a historic masonry building. Soft, incompletely fired brick from the 18th- and early-19th centuries may have become so porous that paint or some type of coating is needed to protect it from further deterioration or dissolution. When a masonry building has been neglected for a long period of time, necessary repairs may be required in order to make it watertight. If, following a reasonable period of time after the building has been made watertight and has dried out completely, moisture appears actually to be penetrating through the repointed and repaired masonry walls, then the application of a water-repellent coating may be considered *in selected areas only*. This decision should be made in consultation with an architectural conservator. And, if such a treatment is undertaken, it should not be applied to the entire exterior of the building.

Anti-graffiti or barrier coatings are another type of clear coating--although barrier coatings can also be pigmented--that may be applied to exterior masonry, but they are not formulated primarily as water repellents. The purpose of these coatings is to make it harder for graffiti to stick to a masonry surface and, thus, easier to clean. But, like water-repellent coatings, in most cases the application of anti-graffiti coatings is generally not recommended for historic masonry buildings. These coatings are often quite shiny which can greatly alter the appearance of a historic masonry surface, and they are not always effective. Generally, other ways of discouraging graffiti, such as improved lighting, can be more effective than a coating. However, the application of anti-graffiti coatings may be appropriate in some instances on vulnerable areas of historic masonry buildings which are frequent targets of graffiti that are located in out-of-the-way places where constant



Improper cleaning methods may have been responsible for the formation of efflorescence on this brick. Photo: NPS files.

surveillance is not possible.

Some water-repellent coatings are recommended by product manufacturers as a means of keeping dirt and pollutants or biological growth from collecting on the surface of masonry buildings and, thus, reducing the need for frequent cleaning. While this at times may be true, in some cases a coating may actually retain dirt more than uncoated masonry. Generally, the application of a water-repellent coating is not recommended on a historic masonry building as a means of preventing biological growth. Some water-repellent coatings may actually encourage biological growth on a masonry wall. Biological growth on masonry buildings has traditionally been kept at bay through regularly-scheduled cleaning as part of a maintenance plan. Simple cleaning of the masonry with low-pressure water using a natural- or synthetic-bristled scrub brush can be very effective if done on a regular basis. Commercial products are also available which can be sprayed on masonry to remove biological growth.

**In most instances, a water-repellent coating is not necessary if a building is watertight.** The application of a water-repellent coating is not a recommended treatment for historic masonry buildings unless there is a specific problem which it may help solve. If the problem occurs on only part of the building, it is best to treat only that area rather than an entire building. Extreme exposures such as parapets, for example, or portions of the building subject to driving rain can be treated more effectively and less expensively than the entire building. Water-repellent coatings are not permanent and must be reapplied periodically although, if they are truly invisible, it can be difficult to know when they are no longer providing the intended protection.

Testing a water-repellent coating by applying it in one small area may not be helpful in determining its suitability for the building because a limited test area does not allow an adequate evaluation of a treatment. Since water may enter and leave through the surrounding untreated areas, there is no way to tell if the coated test area is "breathable." But trying a coating in a small area may help to determine whether the coating is visible on the surface or if it will otherwise change the appearance of the masonry.

## Waterproof Coatings

In theory, waterproof coatings usually do not cause problems as long as they exclude all water from the masonry. If water does enter the wall from the ground or from the inside of a building, the coating can intensify the damage because the water will not be able to escape. During cold weather this water in the wall can freeze causing serious mechanical disruption, such as spalling.

In addition, the water eventually will get out by the path of least resistance. If this path is toward the interior, damage to interior finishes can result; if it is toward the exterior, it can lead to damage to the masonry caused by built-up water pressure.

**In most instances, waterproof coatings should not be applied to historic masonry.** The possible exception to this might be the application of a waterproof coating to below-grade exterior foundation walls as a last resort to stop water infiltration on interior basement walls. **Generally, however, waterproof coatings, which include *elastomeric paints*, should almost never be applied above grade to historic masonry buildings.**

---

## Summary

A well-planned cleaning project is an essential step in preserving, rehabilitating or

restoring a historic masonry building. Proper cleaning methods and coating treatments, when determined necessary for the preservation of the masonry, can enhance the aesthetic character as well as the structural stability of a historic building. Removing years of accumulated dirt, pollutant crusts, stains, graffiti or paint, if done with appropriate caution, can extend the life and longevity of the historic resource. Cleaning that is carelessly or insensitively prescribed or carried out by inexperienced workers can have the opposite of the intended effect. It may scar the masonry permanently, and may actually result in hastening deterioration by introducing harmful residual chemicals and salts into the masonry or causing surface loss. Using the wrong cleaning method or using the right method incorrectly, applying the wrong kind of coating or applying a coating that is not needed can result in serious damage, both physically and aesthetically, to a historic masonry building. Cleaning a historic masonry building should always be done using the gentlest means possible that will clean, but not damage the building. It should always be taken into consideration before applying a water-repellent coating or a waterproof coating to a historic masonry building whether it is really necessary and whether it is in the best interest of preserving the building.

---

## Selected Reading

- Architectural Ceramics: Their History, Manufacture and Conservation*. A Joint Symposium of English Heritage and the United Kingdom Institute for Conservation, September 22-25, 1994. London: English Heritage, 1996.
- Ashurst, Nicola. *Cleaning Historic Buildings. Volume One: Substrates, Soiling & Investigation. Volume Two: Cleaning Materials & Processes*. London: Donhead Publishing Ltd., 1994.
- Association for Preservation Technology. *Special Issue: Preservation of Historic Masonry*. Papers from the Symposium on Preservation Treatments for Historic Masonry: Consolidants, Coatings, and Water Repellents, New York, New York, November 11-12, 1994. *APT Bulletin*. Vol. XXVI, No. 4 (1995).
- Grimmer, Anne E. *Preservation Brief 6: Dangers of Abrasive Cleaning to Historic Buildings*. Washington, DC: Preservation Assistance Division, National Park Service, U.S. Department of the Interior, 1979.
- Grimmer, Anne E. *Keeping it Clean: Removing Exterior Dirt, Paint, Stains and Graffiti from Historic Masonry Buildings*. Washington, DC: Preservation Assistance Division, National Park Service, U.S. Department of the Interior, 1988.
- Park, Sharon C., AIA. *Preservation Brief 39: Holding the Line: Controlling Unwanted Moisture in Historic Buildings*. Washington, DC: Heritage Preservation Services, National Park Service, U.S. Department of the Interior, 1996.
- Powers, Robert M. *Preservation Tech Note, Masonry No. 3, "Water Soak Cleaning of Limestone"*. Washington, DC: Preservation Assistance Division, National Park Service, U.S. Department of the Interior, 1992.
- Sinvinski, Valerie. "Gentle Blasting." *Old-House Journal*. Vol. XXIV, No. 4 (July-August 1996), pp. 46-49.
- Weaver, Martin E. *Conserving Buildings: A Guide to Techniques and Materials*. New York: John Wiley & Sons, Inc., 1993.
- Weaver, Martin E. *Preservation Brief 38: Removing Graffiti from Historic Masonry*. Washington, DC: Preservation Assistance Division, National Park Service, U.S. Department of the Interior, 1995.
- Winkler, E.M. *Stone in Architecture: Properties, Durability*. Third, completely revised and extended edition. Berlin, Germany: Springer-Verlag, 1997.
-

## Acknowledgements

**Robert C. Mack, FAIA**, is a principal in the firm of MacDonald & Mack Architects, Ltd., an architectural firm that specializes in historic buildings in Minneapolis, Minnesota. **Anne Grimmer** is a Senior Architectural Historian in the Technical Preservation Services Branch, Heritage Preservation Services Program, National Park Service, Washington, D.C.

The original version of *Preservation Brief 1: The Cleaning and Waterproof Coating of Masonry Buildings* was written by Robert C. Mack, AIA. It inaugurated the Preservation Briefs series when it was published in 1975.

The following historic preservation specialists provided technical review of this publication: Frances Gale, Training Director, National Center for Preservation Technology and Training, National Park Service, Natchitoches, LA; Judith M. Jacob, Architectural Conservator, Building Conservation Branch, Northeast Cultural Resources Center, National Park Service, N.Y., NY; Robert M. Powers, Architectural Conservator, Powers and Company, Inc., Philadelphia, PA; Antonio Aguilar, Kaaren Dodge, JoEllen Hensley, Gary Sachau, John Sandor and Audrey T. Tepper, Technical Preservation Services Branch, Heritage Preservation Services Program, National Park Service, Washington, DC; and Kay D. Weeks, Heritage Preservation Services Program, National Park Service, Washington, DC.

**Washington, DC November, 2000**

**Home page logo: Appropriate cleaning of historic masonry. Photo: NPS files.**

---

*This publication has been prepared pursuant to the National Historic Preservation Act of 1966, as amended, which directs the Secretary of the Interior to develop and make available information concerning historic properties. Technical Preservation Services (TPS), Heritage Preservation Services Division, National Park Service prepares standards, guidelines, and other educational materials on responsible historic preservation treatments to a broad public.*

---

# 2 Preservation Briefs

Technical Preservation Services

National Park Service  
U.S. Department of the Interior



## Repointing Mortar Joints in Historic Masonry Buildings

Robert C. Mack, FAIA, and John P. Speweik

» [Historical Background](#)

[Identifying the Problem Before Repointing](#)

» [Finding an Appropriate Mortar Match](#)

» [Properties of Mortar](#)

» [Mortar Analysis](#)

» [Components of Mortar](#)

» [Mortar Type and Mix](#)

» [Budgeting and Scheduling](#)

» [Contractor Selection](#)

» [Execution of the Work](#)

» [Visually Examining the Mortar and the Masonry Units](#)

» [Summary](#)

» [Conclusion](#)

» [Selected Reading](#)

**A NOTE TO OUR USERS:** The web versions of the **Preservation Briefs** differ somewhat from the printed versions. Many illustrations are new, captions are simplified, illustrations are typically in color rather than black and white, and some complex charts have been omitted.



**Masonry--brick, stone, terra-cotta, and concrete block--is found on nearly every historic building.** Structures with all-masonry exteriors come to mind immediately, but most other buildings at least have masonry foundations or chimneys. Although generally considered "permanent," masonry is subject to deterioration, especially at the mortar joints. Repointing, also known simply as "pointing" or-- somewhat inaccurately--"tuck pointing"\*, is the process of removing deteriorated mortar from the joints of a masonry wall and replacing it with new mortar. Properly done, repointing restores the visual and physical integrity of the masonry. Improperly done, repointing not only detracts from the appearance of the building, but may also cause physical damage to the masonry units themselves.

The purpose of this Brief is to provide general guidance on appropriate materials and methods for repointing historic masonry buildings and it is intended to benefit building owners, architects, and contractors. The Brief should serve as a guide to prepare specifications for repointing historic masonry buildings. It should also help develop sensitivity to the particular needs of historic masonry, and to assist historic building owners in working cooperatively with architects, architectural conservators and historic preservation consultants, and contractors. Although specifically intended for historic

buildings, the guidance is appropriate for other masonry buildings as well. This publication updates *Preservation Briefs 2: Repointing Mortar Joints in Historic Brick Buildings* to include all types of historic unit masonry. The scope of the earlier Brief has also been expanded to acknowledge that the many buildings constructed in the first half of the 20th century are now historic and eligible for listing in the National Register of Historic Places, and that they may have been originally constructed with portland cement mortar.

*\* Tuckpointing technically describes a primarily decorative application of a raised mortar joint or lime putty joint on top of flush mortar joints.*

---

## Historical Background

Mortar consisting primarily of lime and sand has been used as an integral part of masonry structures for thousands of years. Up until about the mid-19th century, lime or quicklime (sometimes called lump lime) was delivered to construction sites, where it had to be slaked, or combined with water. Mixing with water caused it to boil and resulted in a wet lime putty that was left to mature in a pit or wooden box for several weeks, up to a year. Traditional mortar was made from lime putty, or slaked lime, combined with local sand, generally in a ratio of 1 part lime putty to 3 parts sand by volume. Often other ingredients, such as crushed marine shells (another source of lime), brick dust, clay, natural cements, pigments, and even animal hair were also added to mortar, but the basic formulation for lime putty and sand mortar remained unchanged for centuries until the advent of portland cement or its forerunner, Roman cement, a natural, hydraulic cement.

**Portland cement** was patented in Great Britain in 1824. It was named after the stone from Portland in Dorset which it resembled when hard. This is a fast-curing, hydraulic cement which hardens under water. Portland cement was first manufactured in the United States in 1872, although it was imported before this date. But it was not in common use throughout the country until the early 20th century. Up until the turn of the century portland cement was considered primarily an additive, or "minor ingredient" to help accelerate mortar set time. By the 1930s, however, most masons used a mix of equal parts portland cement and lime putty. Thus, the mortar found in masonry structures built between 1873 and 1930 can range from pure lime and sand mixes to a wide variety of lime, portland cement, and sand combinations.

In the 1930s more new mortar products intended to hasten and simplify masons' work were introduced in the U.S. These included **masonry cement**, a premixed, bagged mortar which is a combination of portland cement and ground limestone, and **hydrated lime**, machine-slaked lime that eliminated the necessity of slaking quicklime into putty at the site.

---

## Identifying the Problem Before Repointing

The decision to repoint is most often related to some obvious sign of deterioration, such as disintegrating mortar, cracks in mortar joints, loose bricks or stones, damp walls, or

damaged plasterwork. It is, however, erroneous to assume that repointing alone will solve deficiencies that result from other problems. The root cause of the deterioration--leaking roofs or gutters, differential settlement of the building, capillary action causing rising damp, or extreme weather exposure--should always be dealt with prior to beginning work.

Without appropriate repairs to eliminate the source of the problem, mortar deterioration will continue and any repointing will have been a waste of time and money.

**Use of Consultants.** Because there are so many possible causes for deterioration in historic buildings, it may be desirable to retain a consultant, such as a historic architect or architectural conservator, to analyze the building. In addition to determining the most appropriate solutions to the problems, a consultant can prepare specifications which reflect the particular requirements of each job

and can provide oversight of the work in progress. Referrals to preservation consultants frequently can be obtained from State Historic Preservation Offices, the American Institute for Conservation of Historic and Artistic Works (AIC), the Association for Preservation Technology (APT), and local chapters of the American Institute of Architects (AIA).



Masons practice using lime putty mortar to repair historic marble. Photo: NPS files.

---

## Finding an Appropriate Mortar Match

Preliminary research is necessary to ensure that the proposed repointing work is both physically and visually appropriate to the building. Analysis of unweathered portions of the historic mortar to which the new mortar will be matched can suggest appropriate mixes for the repointing mortar so that it will not damage the building because it is excessively strong or vapor impermeable.



This late 19th century granite has recently been repointed with the joint profile and mortar color carefully matched to the original. Photo: NPS files.

Examination and analysis of the masonry units--brick, stone or terra cotta--and the techniques used in the original construction will assist in maintaining the building's historic appearance. A simple, non-technical, evaluation of the masonry units and mortar can provide information concerning the relative strength and permeability of each--critical factors in selecting the repointing mortar--while a visual analysis of the historic mortar can provide the information necessary for developing the new mortar mix and application techniques.

Although not crucial to a successful repointing project, for projects involving properties of special historic significance, a mortar analysis by a qualified

laboratory can be useful by providing information on the original ingredients. However, there are limitations with such an analysis, and replacement mortar specifications should not be based solely on laboratory analysis. Analysis requires interpretation, and there are important factors which affect the condition and performance of the mortar that cannot be established through laboratory analysis. These may include: the original water content, rate of curing, weather conditions during original construction, the method of mixing and placing the mortar, and the cleanliness and condition of the sand. *The most useful information that can come out of laboratory analysis is the identification of sand by gradation and color.* This allows the color and the texture of the mortar to be matched with some accuracy because sand is the largest ingredient by volume.

In creating a repointing mortar that is compatible with the masonry units, the objective is to achieve one that matches the historic mortar as closely as possible, so that the new material can coexist with the old in a sympathetic, supportive and, if necessary, sacrificial capacity. The exact physical and chemical properties of the historic mortar are not of major significance as long as the new mortar conforms to the following criteria:

- The new mortar must match the historic mortar in **color, texture and tooling**. (If a laboratory analysis is undertaken, it may be possible to match the binder components and their proportions with the historic mortar, if those materials are available.)
- The **sand must match the sand** in the historic mortar. (The color and texture of the new mortar will usually fall into place if the sand is matched successfully.)
- The new mortar must have **greater vapor permeability** and be **softer** (measured in compressive strength) than the masonry units.
- The new mortar must be **as vapor permeable** and **as soft or softer** (measured in compressive strength) than the historic mortar. (Softness or hardness is not necessarily an indication of permeability; old, hard lime mortars can still retain high permeability.)



This mortar is the proper consistency for repointing historic brick. Photo: John P. Speweik.

## Mortar Analysis

Methods for analyzing mortars can be divided into two broad categories: **wet chemical** and **instrumental**. Many laboratories that analyze historic mortars use a simple **wet-chemical** method called acid digestion, whereby a sample of the mortar is crushed and then mixed with a dilute acid. The acid dissolves all the carbonate-containing minerals not only in the binder, but also in the aggregate (such as oyster shells, coral sands, or other carbonate-based materials), as well as any other acid-soluble materials. The sand and fine-grained acid-insoluble material is left behind. There are several variations on the simple acid digestion test. One involves collecting the carbon dioxide gas given off as the carbonate is digested by the acid; based on the gas volume the carbonate content of the mortar can be accurately determined (Jedrzejewska, 1960). Simple acid digestion methods are rapid, inexpensive, and easy to perform, but the information they provide about the original composition of a mortar

is limited to the color and texture of the sand. The gas collection method provides more information about the binder than a simple acid digestion test.

**Instrumental** analysis methods that have been used to evaluate mortars include polarized light or thin-section microscopy, scanning electron microscopy, atomic absorption spectroscopy, X-ray diffraction, and differential thermal analysis. All instrumental methods require not only expensive, specialized equipment, but also highly-trained experienced analysts. However, instrumental methods can provide much more information about a mortar. Thin-section microscopy is probably the most commonly used instrumental method. Examination of thin slices of a mortar in transmitted light is often used to supplement acid digestion methods, particularly to look for carbonate-based aggregate. For example, the new ASTM test method, ASTM C 1324-96 "Test Method for Examination and Analysis of Hardened Mortars" which was designed specifically for the analysis of modern lime-cement and masonry cement mortars, combines a complex series of wet chemical analyses with thin-section microscopy.

The drawback of most mortar analysis methods is that mortar samples of known composition have not been analyzed in order to evaluate the method. Historic mortars were not prepared to narrowly defined specifications from materials of uniform quality; they contain a wide array of locally derived materials combined at the discretion of the mason. While a particular method might be able to accurately determine the original proportions of a lime-cement-sand mortar prepared from modern materials, the usefulness of that method for evaluating historic mortars is questionable unless it has been tested against mortars prepared from materials more commonly used in the past. **Lorraine Schnabel.**

---

## Properties of Mortar

Mortars for repointing should be softer or more permeable than the masonry units and no harder or more impermeable than the historic mortar to prevent damage to the masonry units. It is a common error to assume that hardness or high strength is a measure of appropriateness, particularly for lime-based historic mortars. Stresses within a wall caused by expansion, contraction, moisture migration, or settlement must be accommodated in some manner; in a masonry wall, these stresses should be relieved by the mortar rather than by the masonry units. A mortar that is stronger in compressive strength than the masonry units will not "give," thus causing stresses to be relieved through the masonry units--resulting in permanent damage to the masonry, such as cracking and spalling, that cannot be repaired easily.

While stresses can also break the bond between the mortar and the masonry units, permitting water to penetrate the resulting hairline cracks, this is easier to correct in the joint through repointing than if the break occurs in the masonry units.

Permeability, or rate of vapor transmission, is also critical. High lime mortars are more permeable than denser cement mortars. Historically, mortar acted as a bedding material--not unlike an expansion joint--rather than a "glue" for the masonry units, and moisture was able to migrate through the mortar joints rather than the masonry units. When moisture evaporates from the masonry it deposits any soluble salts either on the surface as *efflorescence* or below the surface as *subflorescence*. While salts deposited on the surface of masonry units are usually relatively harmless, salt crystallization within a masonry unit creates pressure that can cause parts of the outer surface to spall off or delaminate. If the mortar does not permit moisture or moisture vapor to migrate out of the wall and evaporate, the result will be damage to the masonry units.



This early 19th century building is being repointed with lime mortar. Photo: Travis McDonald.

---

## Components of Mortar

**Sand.** Sand is the largest component of mortar and the material that gives mortar its distinctive color, texture and cohesiveness. Sand must be free of impurities, such as salts or clay. The three key characteristics of sand are: particle shape, gradation and void ratios.

When viewed under a magnifying glass or low-power microscope, particles of sand generally have either rounded edges, such as found in beach and river sand, or sharp, angular edges, found in crushed or manufactured sand. For repointing mortar, rounded or natural sand is preferred for two reasons. It is usually similar to the sand in the historic mortar and provides a better visual match. It also has better working qualities or plasticity and can thus be forced into the joint more easily, forming a good contact with the remaining historic mortar and the surface of the adjacent masonry units. Although manufactured sand is frequently more readily available, it is usually possible to locate a supply of rounded sand.

The gradation of the sand (particle size distribution) plays a very important role in the durability and cohesive properties of a mortar. Mortar must have a certain percentage of large to small particle sizes in order to deliver the optimum performance. Acceptable guidelines on particle size distribution may be found in ASTM C 144 (American Society for Testing and Materials). However, in actuality, since neither historic nor modern sands are always in compliance with ASTM C 144, matching the same particle appearance and gradation usually requires sieving the sand.

A scoop of sand contains many small voids between the individual grains. A mortar that performs well fills all these small voids with binder (cement/lime combination or mix) in a balanced manner. Well-graded sand generally has a 30 per cent void ratio by volume.

Thus, 30 per cent binder by volume generally should be used, unless the historic mortar had a different binder: aggregate ratio. This represents the 1:3 binder to sand ratios often seen in mortar specifications.

For repointing, sand generally should conform to ASTM C 144 to assure proper gradation and freedom from impurities; some variation may be necessary to match the original size and gradation. Sand color and texture also should match the original as closely as possible to provide the proper color match without other additives.

**Lime.** Mortar formulations prior to the late-19th century used lime as the primary binding material. Lime is derived from heating limestone at high temperatures which burns off the carbon dioxide, and turns the limestone into quicklime. There are three types of limestone--calcium, magnesium, and dolomitic--differentiated by the different levels of magnesium carbonate they contain which impart specific qualities to mortar. Historically, calcium lime was used for mortar rather than the dolomitic lime (calcium magnesium carbonate) most often used today. But it is also important to keep in mind the fact that the historic limes, and other components of mortar, varied a great deal because they were natural, as opposed to modern lime which is manufactured and, therefore, standardized. Because some of the kinds of lime, as well as other components of mortar, that were used historically are no longer readily available, even when a conscious effort is made to replicate a "historic" mix, this may not be achievable due to the differences between modern and historic materials.



Caulking was inappropriately used here in place of mortar on the top of the wall. As a result, it has not been durable. Photo: NPS files.

Lime, itself, when mixed with water into a paste is very plastic and creamy. It will remain workable and soft indefinitely, if stored in a sealed container. Lime (calcium hydroxide) hardens by carbonation absorbing carbon dioxide primarily from the air, converting itself to calcium carbonate. Once a lime and sand mortar is mixed and placed in a wall, it begins the process of carbonation. If lime mortar is left to dry too rapidly, carbonation of the mortar will be reduced, resulting in poor adhesion and poor durability. In addition, lime mortar is slightly water soluble and thus is able to re-seal any hairline cracks that may develop during the life of the

mortar. Lime mortar is soft, porous, and changes little in volume during temperature fluctuations thus making it a good choice for historic buildings. *Because of these qualities, high calcium lime mortar may be considered for many repointing projects, not just those involving historic buildings.*

For repointing, lime should conform to ASTM C 207, Type S, or Type SA, Hydrated Lime for Masonry Purposes. This machine-slaked lime is designed to assure high plasticity and water retention. The use of quicklime which must be slaked and soaked by hand may have advantages over hydrated lime in some restoration projects if time and money allow.

**Lime putty.** Lime putty is slaked lime that has a putty or paste-like consistency. It should conform to ASTM C 5. Mortar can be mixed using lime putty according to ASTM C

270 property or proportion specification.

**Portland cement.** More recent, 20th-century mortar has used portland cement as a primary binding material. A straight portland cement and sand mortar is extremely hard, resists the movement of water, shrinks upon setting, and undergoes relatively large thermal movements. When mixed with water, portland cement forms a harsh, stiff paste that is quite unworkable, becoming hard very quickly. (Unlike lime, portland cement will harden regardless of weather conditions and does not require wetting and drying cycles.) Some portland cement assists the workability and plasticity of the mortar without adversely affecting the finished project; it also provides early strength to the mortar and speeds setting. Thus, it may be appropriate to add some portland cement to an essentially lime-based mortar even when repointing relatively soft 18th or 19th century brick under some circumstances when a slightly harder mortar is required. The more portland cement that is added to a mortar formulation the harder it becomes--and the faster the initial set.

For repointing, portland cement should conform to ASTM C 150. White, non-staining portland cement may provide a better color match for some historic mortars than the more commonly available grey portland cement. But, it should not be assumed, however, that white portland cement is always appropriate for all historic buildings, since the original mortar may have been mixed with grey cement. The cement should not have more than 0.60 per cent alkali to help avoid efflorescence.

**Masonry cement.** Masonry cement is a preblended mortar mix commonly found at hardware and home repair stores. It is designed to produce mortars with a compressive strength of 750 psi or higher when mixed with sand and water at the job site. It may contain hydrated lime, but it always contains a large amount of portland cement, as well as ground limestone and other workability agents, including air-entraining agents. Because masonry cements are not required to contain hydrated lime, and generally do not contain lime, they produce high strength mortars that can damage historic masonry. *For this reason, they generally are not recommended for use on historic masonry buildings.*

**Lime mortar (pre-blended).** Hydrated lime mortars, and pre-blended lime putty mortars with or without a matched sand are commercially available. Custom mortars are also available with color. In most instances, pre-blended lime mortars containing sand may not provide an exact match; however, if the project calls for total repointing, a pre-blended lime mortar may be worth considering as long as the mortar is compatible in strength with the masonry. If the project involves only selected, "spot" repointing, then it may be better to carry out a mortar analysis which can provide a custom pre-blended lime mortar with a matching sand. In either case, if a preblended lime mortar is to be used, it should contain Type S or SA hydrated lime conforming to ASTM C 207.

**Water.** Water should be potable--clean and free from acids, alkalis, or other dissolved organic materials.

## Other Components

**Historic components.** In addition to the color of the sand, the texture of the mortar is of critical importance in duplicating historic mortar. Most mortars dating from the mid-19th century on--with some exceptions--have a fairly homogeneous texture and color.

Some earlier mortars are not as uniformly textured and may contain lumps of partially burned lime or "dirty lime", shell (which often provided a source of lime, particularly in coastal areas), natural cements, pieces of clay, lampblack or other pigments, or even animal hair. The visual characteristics of these mortars can be duplicated through the use of similar materials in the repointing mortar.

Replicating such unique or individual mortars will require writing new specifications for each project. If possible, suggested sources for special materials should be included. For example, crushed oyster shells can be obtained in a variety of sizes from poultry supply dealers.

**Pigments.** Some historic mortars, particularly in the late 19th century, were tinted to match or contrast with the brick or stone. Red pigments, sometimes in the form of brick dust, as well as brown, and black pigments were commonly used. Modern pigments are available which can be added to the mortar at the job site, but they should not exceed 10 per cent by weight of the portland cement in the mix, and carbon black should be limited to 2 per cent. Only synthetic mineral oxides, which are alkali-proof and sun-fast, should be used to prevent bleaching and fading.

**Modern components.** Admixtures are used to create specific characteristics in mortar, and whether they should be used will depend upon the individual project. *Air entraining agents*, for example, help the mortar to resist freeze-thaw damage in northern climates. *Accelerators* are used to reduce mortar freezing prior to setting while *retarders* help to extend the mortar life in hot climates. Selection of admixtures should be made by the architect or architectural conservator as part of the specifications, not something routinely added by the masons.

Generally, modern chemical additives are unnecessary and may, in fact, have detrimental effects in historic masonry projects. The use of antifreeze compounds is not recommended. They are not very effective with high lime mortars and may introduce salts, which may cause efflorescence later. A better practice is to warm the sand and water, and to protect the completed work from freezing. No definitive study has determined whether air-entraining additives should be used to resist frost action and enhance plasticity, but in areas of extreme exposure requiring high-strength mortars with lower permeability, air-entrainment of 10-16 percent may be desirable (see formula for "severe weather exposure" in **Mortar Type and Mix**). Bonding agents are not a substitute for proper joint preparation, and they should generally be avoided. If the joint is properly prepared, there will be a good bond between the new mortar and the adjacent surfaces. In addition, a bonding agent is difficult to remove if smeared on a masonry surface.

## **Mortar Type and Mix**

Mortars for repointing projects, especially those involving historic buildings, typically are custom mixed in order to ensure the proper physical and visual qualities. These materials can be combined in varying proportions to create a mortar with the desired performance and durability. The actual specification of a particular mortar type should take into consideration all of the factors affecting the life of the building including: current site conditions, present condition of the masonry, function of the new mortar, degree of weather exposure, and skill of the mason.



Here, a hammer and chisel are being correctly used to prepare a joint for repointing. Photo: John P. Speweik.

Thus, no two repointing projects are exactly the same. Modern materials specified for use in repointing mortar should conform to specifications of the American Society for Testing and Materials (ASTM) or comparable federal specifications, and the resulting mortar should conform to ASTM C 270, Mortar for Unit Masonry.

Specifying the proportions for the repointing mortar for a specific job is not as difficult as it might seem. Five mortar types, each with a corresponding recommended mix, have been established by ASTM to distinguish high strength mortar from soft flexible mortars. The ASTM designated them in decreasing order of approximate general strength as Type M (2,500 psi), Type S (1,800 psi), Type N (750 psi), Type O (350 psi) and Type K (75 psi). (The letters identifying the types are from the words MASON WORK using every other letter.) Type K has the highest lime content of the mixes that contain portland cement, although it is seldom used today, except for some historic preservation projects. The designation "L" in the accompanying chart identifies a straight lime and sand mix. Specifying the appropriate ASTM

mortar by proportion of ingredients, will ensure the desired physical properties. Unless specified otherwise, measurements or proportions for mortar mixes are always given in the following order: cement-lime-sand. Thus, a Type K mix, for example, would be referred to as 1-3-10, or 1 part cement to 3 parts lime to 10 parts sand. Other requirements to create the desired visual qualities should be included in the specifications.

The strength of a mortar can vary. If mixed with higher amounts of portland cement, a harder mortar is obtained. The more lime that is added, the softer and more plastic the mortar becomes, increasing its workability. A mortar strong in compressive strength might be desirable for a hard stone (such as granite) pier holding up a bridge deck, whereas a softer, more permeable lime mortar would be preferable for a historic wall of soft brick. Masonry deterioration caused by salt deposition results when the mortar is less permeable than the masonry unit. A strong mortar is still more permeable than hard, dense stone. However, in a wall constructed of soft bricks where the masonry unit itself has a relatively high permeability or vapor transmission rate, a soft, high lime mortar is necessary to retain sufficient permeability.

---

## Budgeting and Scheduling

Repointing is both expensive and time consuming due to the extent of handwork and special materials required. It is preferable to repoint only those areas that require work rather than an entire wall, as is often specified. But, if 25 to 50 per cent or more of a wall needs to be repointed, repointing the entire wall may be more cost effective than spot repointing.

Total repointing may also be more sensible when access is difficult, requiring the erection of expensive scaffolding (unless the majority of the mortar is sound and unlikely to require replacement in the foreseeable future). Each project requires judgement based on a variety of factors. Recognizing this at the outset will help to prevent many jobs from becoming prohibitively expensive.



When repairing this stone wall, the mason matched the raised profile of the original tuckpointing. Photo: NPS files.

In scheduling, seasonal aspects need to be considered first. Generally speaking, wall temperatures between 40 and 95 degrees F (8 and 38 degrees C) will prevent freezing or excessive evaporation of the water in the mortar. Ideally, repointing should be done in shade, away from strong sunlight in order to slow the drying process, especially during hot weather. If necessary, shade can be provided for large-scale projects with appropriate modifications to scaffolding.

The relationship of repointing to other work proposed on the building must also be recognized. For example, if paint removal or cleaning is anticipated, and if the mortar joints are basically sound and need only selective repointing, it is generally better to postpone repointing until after completion of these activities. However, if the mortar has eroded badly, allowing moisture to penetrate deeply into the wall, repointing should be accomplished before cleaning. Related work, such as structural or roof repairs, should be scheduled so that they do not interfere with repointing and so that all work can take maximum advantage of erected scaffolding.

Building managers also must recognize the difficulties that a repointing project can create.



A mechanical grinder improperly used to cut out the horizontal joint and incompatible repointing have seriously damaged the 19th century brick. Photo: NPS files.

The process is time consuming, and scaffolding may need to remain in place for an extended period of time. The joint preparation process can be quite noisy and can generate large quantities of dust which must be controlled, especially at air intakes to protect human health, and also where it might damage operating machinery. Entrances may be blocked from time to time making access difficult for both building tenants and visitors. Clearly, building managers will need to coordinate the repointing work with other events at the site.

## Contractor Selection

The ideal way to select a contractor is to ask knowledgeable owners of recently repointed historic buildings for recommendations. Qualified contractors then can provide lists of other repointing projects for inspection. More commonly, however, the contractor for a repointing project is selected through a competitive bidding process over which the client or consultant has only limited control. In this situation it is important to ensure that the specifications stipulate that masons must have a minimum

of five years' experience with repointing historic masonry buildings to be eligible to bid on the project. Contracts are awarded to the lowest responsible bidder, and bidders who have performed poorly on other projects usually can be eliminated from consideration on this basis, even if they have the lowest prices.

The contract documents should call for unit prices as well as a base bid. Unit pricing forces the contractor to determine in advance what the cost addition or reduction will be for work which varies from the scope of the base bid. If, for example, the contractor has fifty linear feet less of stone repointing than indicated on the contract documents but thirty linear feet more of brick repointing, it will be easy to determine the final price for the work. Note that each type of work--brick repointing, stone repointing, or similar items--will have its own unit price. The unit price also should reflect quantities; one linear foot of pointing in five different spots will be more expensive than five contiguous linear feet.

## Execution of the Work

**Test Panels.** These panels are prepared by the contractor using the same techniques that will be used on the remainder of the project. Several panel locations--preferably not on the front or other highly visible location of the building--may be necessary to include all types of masonry, joint styles, mortar colors, and other problems likely to be encountered on the job.

If cleaning tests, for example, are also to be undertaken, they should be carried out in the same location. Usually a 3 foot by 3 foot area is sufficient for brickwork, while a somewhat larger area may be required for stonework. These panels establish an acceptable standard of work and serve as a benchmark for evaluating and accepting subsequent work on the building.

**Joint Preparation.** Old mortar should be removed to a minimum depth of 2 to 2-1/2 times the width of the joint to ensure an adequate bond and to prevent mortar "popouts." For most brick joints, this will require removal of the mortar to a depth of approximately 1/2 to 1 inch; for stone masonry with wide joints, mortar may need to be removed to a depth of several inches. Any loose or disintegrated mortar beyond this minimum depth also should be removed.

Although some damage may be inevitable, careful joint preparation can help limit damage to masonry units. The traditional manner of removing old mortar is through the use of hand chisels and mash hammers. Though labor-intensive, in most instances this method poses the least threat for damage to historic masonry units and produces the best final product.

The most common method of removing mortar, however, is through the use of power saws or grinders. The use of power tools by unskilled masons can be disastrous for historic masonry, particularly soft brick. Using power saws on walls with thin joints, such as most brick walls, almost always will result in damage to the masonry units by breaking the edges and by overcutting on the head, or vertical joints.



Unskilled repointing has negatively impacted the character of this late-19th century building. Photo: NPS files.

However, small pneumatically-powered chisels generally can be used safely and effectively to remove mortar on historic buildings as long as the masons maintain appropriate control over the equipment. Under certain circumstances, thin diamond-bladed grinders may be used to cut out *horizontal* joints only on hard portland cement mortar common to most early-20th century masonry buildings. Usually, automatic tools most successfully remove old mortar without damaging the masonry units when they are used in combination with hand tools in preparation for repointing. Where horizontal joints are uniform and fairly wide, it may be possible to use a power masonry saw to assist the removal of mortar, such as by cutting along the middle of the joint; final mortar removal from the sides of the joints still should be done with a hand chisel and hammer. Caulking cutters with diamond blades can sometimes be used successfully to cut out joints without damaging the masonry. Caulking cutters are slow; they do not rotate, but vibrate at very high speeds, thus minimizing the possibility of damage to masonry units. Although mechanical tools may be safely used in limited circumstances to cut out horizontal joints in preparation for repointing, they should never be used on vertical joints because of the danger of slipping and cutting into the brick above or below the vertical joint. Using power tools to remove mortar without damaging the surrounding masonry units also necessitates highly skilled masons experienced in working on historic masonry buildings. Contractors should demonstrate proficiency with power tools before their use is approved.

Using any of these power tools may also be more acceptable on hard stone, such as quartzite or granite, than on terra cotta with its glass-like glaze, or on soft brick or stone. The test panel should determine the acceptability of power tools. If power tools are to be permitted, the contractor should establish a quality control program to account for worker fatigue and similar variables.

Mortar should be removed cleanly from the masonry units, leaving square corners at the back of the cut. Before filling, the joints should be rinsed with a jet of water to remove all loose particles and dust. At the time of filling, the joints should be damp, but with no standing water present. For masonry walls--limestone, sandstone and common brick--that are extremely absorbent, it is recommended that a continual mist of water be applied for a few hours before repointing begins.

**Mortar Preparation.** Mortar components should be measured and mixed carefully to assure the uniformity of visual and physical characteristics. Dry ingredients are measured by volume and thoroughly mixed before the addition of any water. Sand must be added in a damp, loose condition to avoid over sanding. Repointing mortar is typically pre-hydrated by adding water so it will just hold together, thus allowing it to stand for a period of time before the final water is added. Half the water should be added, followed by mixing for approximately 5 minutes. The remaining water should then be added in small portions until a mortar of the desired consistency is reached. The total volume of water necessary may vary from batch to batch, depending on weather conditions. It is important to keep the water to a minimum for two reasons: first, a drier mortar is cleaner to work with, and it can be compacted tightly into the joints; second, with no excess water to evaporate, the mortar cures without shrinkage cracks. Mortar should be used within approximately 30 minutes of final mixing, and "retempering," or adding more water, should not be permitted.

**Using Lime Putty to Make Mortar.** Mortar made with lime putty and sand, sometimes referred to as roughage or course stuff, should be measured by volume, and may require slightly different proportions from those used with hydrated lime. No additional

water is usually needed to achieve a workable consistency because enough water is already contained in the putty. Sand is proportioned first, followed by the lime putty, then mixed for five minutes or until all the sand is thoroughly coated with the lime putty. But mixing, in the familiar sense of turning over with a hoe, sometimes may not be sufficient if the best possible performance is to be obtained from a lime putty mortar. Although the old practice of chopping, beating and ramming the mortar has largely been forgotten, recent field work has confirmed that lime putty and sand rammed and beaten with a wooden mallet or ax handle, interspersed by chopping with a hoe, can significantly improve workability and performance. The intensity of this action increases the overall lime/sand contact and removes any surplus water by compacting the other ingredients. It may also be advantageous for larger projects to use a mortar pan mill for mixing. Mortar pan mills which have a long tradition in Europe produce a superior lime putty mortar not attainable with today's modern paddle and drum type mixers.

For larger repointing projects the lime putty and sand can be mixed together ahead of time and stored indefinitely, on or off site, which eliminates the need for piles of sand on the job site. This mixture, which resembles damp brown sugar, must be protected from the air in sealed containers with a wet piece of burlap over the top or sealed in a large plastic bag to prevent evaporation and premature carbonation. The lime putty and sand mixture can be recombined into a workable plastic state months later with no additional water.

If portland cement is specified in a lime putty and sand mortar--Type O (1:2:9) or Type K (1:3:11)--the portland cement should first be mixed into a slurry paste before adding it to the lime putty and sand. Not only will this ensure that the portland cement is evenly distributed throughout the mixture, but if dry portland cement is added to wet ingredients it tends to "ball up," jeopardizing dispersion. (Usually water must be added to the lime putty and sand anyway once the portland cement is introduced.) Any color pigments should be added at this stage and mixed for a full five minutes. The mortar should be used within 30 minutes to 1½ hours and it should not be retempered. Once portland cement has been added the mortar can no longer be stored.

**Filling the Joint.** Where existing mortar has been removed to a depth of greater than 1 inch, these deeper areas should be filled first, compacting the new mortar in several layers. The back of the entire joint should be filled successively by applying approximately 1/4 inch of mortar, packing it well into the back corners. This application may extend along the wall for several feet. As soon as the mortar has reached thumb-print hardness, another 1/4 inch layer of mortar--approximately the same thickness--may be applied. Several layers will be needed to fill the joint flush with the outer surface of the masonry. It is important to allow each layer time to harden before the next layer is applied; most of the mortar shrinkage occurs during the hardening process and layering thus minimizes overall shrinkage.

When the final layer of mortar is thumb-print hard, the joint should be tooled to match the historic joint. Proper timing of the tooling is important for uniform color and appearance. If tooled when too soft, the color will be lighter than expected, and hairline cracks may occur; if tooled when too hard, there may be dark streaks called "tool burning," and good closure of the mortar against the masonry units will not be achieved.

If the old bricks or stones have worn, rounded edges, it is best to recess the final mortar slightly from the face of the masonry. This treatment will help avoid a joint which is visually wider than the actual joint; it also will avoid creation of a large, thin featheredge

which is easily damaged, thus admitting water. After tooling, excess mortar can be removed from the edge of the joint by brushing with a natural bristle or nylon brush. Metal bristle brushes should never be used on historic masonry.

**Curing Conditions.** The preliminary hardening of high-lime content mortars--those mortars that contain more lime by volume than portland cement, i.e., Type O (1:2:9), Type K (1:3:11), and straight lime/sand, Type "L" (0:1:3)--takes place fairly rapidly as water in the mix is lost to the porous surface of the masonry and through evaporation. A high lime mortar (especially Type "L") left to dry out too rapidly can result in chalking, poor adhesion, and poor durability. Periodic wetting of the repointed area after the mortar joints are thumb-print hard and have been finish tooled may significantly accelerate the carbonation process. When feasible, misting using a hand sprayer with a fine nozzle can be simple to do for a day or two after repointing. Local conditions will dictate the frequency of wetting, but initially it may be as often as every hour and gradually reduced to every three or four hours. Walls should be covered with burlap for the first three days after repointing. (Plastic may be used, but it should be tented out and not placed directly against the wall.) This helps keep the walls damp and protects them from direct sunlight. Once carbonation of the lime has begun, it will continue for many years and the lime will gain strength as it reverts back to calcium carbonate within the wall.

**Aging the Mortar.** Even with the best efforts at matching the existing mortar color, texture, and materials, there will usually be a visible difference between the old and new work, partly because the new mortar has been matched to the unweathered portions of the historic mortar. Another reason for a slight mismatch may be that the sand is more exposed in old mortar due to the slight erosion of the lime or cement. Although spot repointing is generally preferable and some color difference should be acceptable, if the difference between old and new mortar is too extreme, it may be advisable in some instances to repoint an entire area of a wall, or an entire feature such as a bay, to minimize the difference between the old and the new mortar. If the mortars have been properly matched, usually the best way to deal with surface color differences is to let the mortars age naturally. Other treatments to overcome these differences, including cleaning the non-repointed areas or staining the new mortar, should be carefully tested prior to implementation.



This 18th century pediment and surrounding wall exhibit distinctively different mortar joints. Photo: NPS files.

Staining the new mortar to achieve a better color match is generally not recommended, but it may be appropriate in some instances. Although staining may provide an initial match, the old and new mortars may weather at different rates, leading to visual differences after a few seasons. In addition, the mixtures used to stain the mortar may be harmful to the masonry; for example, they may introduce salts into the masonry which can lead to efflorescence.

**Cleaning the Repointed Masonry.** If repointing work is carefully executed, there will be little need for cleaning other than to remove the small amount of mortar from the edge of the joint following tooling. This can be done with a stiff natural bristle or nylon brush after the mortar has dried, but before it is initially set (1-2 hours). Mortar that has

hardened can usually be removed with a wooden paddle or, if necessary, a chisel.

Further cleaning is best accomplished with plain water and natural bristle or nylon brushes. If chemicals must be used, they should be selected with extreme caution. Improper cleaning can lead to deterioration of the masonry units, deterioration of the mortar, mortar smear, and efflorescence. New mortar joints are especially susceptible to damage because they do not become fully cured for several months. Chemical cleaners, particularly acids, should never be used on dry masonry. The masonry should always be completely soaked once with water before chemicals are applied. After cleaning, the walls should be flushed again with plain water to remove all traces of the chemicals.

Several precautions should be taken if a freshly repointed masonry wall is to be cleaned. First, the mortar should be fully hardened before cleaning. Thirty days is usually sufficient, depending on weather and exposure; as mentioned previously, the mortar will continue to cure even after it has hardened. Test panels should be prepared to evaluate the effects of different cleaning methods. Generally, on newly repointed masonry walls, only very low pressure (100 psi) water washing supplemented by stiff natural bristle or nylon brushes should be used, except on glazed or polished surfaces, where only soft cloths should be used.\*\*

New construction "bloom" or efflorescence occasionally appears within the first few months of repointing and usually disappears through the normal process of weathering. If the efflorescence is not removed by natural processes, the safest way to remove it is by dry brushing with stiff natural or nylon bristle brushes followed by wet brushing. Hydrochloric (muriatic) acid, is generally ineffective, and it should not be used to remove efflorescence. It may liberate additional salts, which, in turn, can lead to more efflorescence.

**Surface Grouting** is sometimes suggested as an alternative to repointing brick buildings, in particular. This process involves the application of a thin coat of cement-based grout to the mortar joints and the mortar/brick interface. To be effective, the grout must extend slightly onto the face of the masonry units, thus widening the joint visually. The change in the joint appearance can alter the historic character of the structure to an unacceptable degree. In addition, although masking of the bricks is intended to keep the grout off the remainder of the face of the bricks, some level of residue, called "veiling," will inevitably remain. Surface grouting cannot substitute for the more extensive work of repointing, and it is not a recommended treatment for historic masonry.

*\*\*Additional information on masonry cleaning is presented in Preservation Briefs 1: Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings, Robert C. Mack, FAIA, and Anne Grimmer, Washington, D.C.: Technical Preservation Services, National Park Service, U.S. Department of the Interior, 2000; and Keeping it Clean: Removing Exterior Dirt, Paint, Stains & Graffiti from Historic Masonry Buildings, Anne E. Grimmer, Washington, D.C.: Technical Preservation Services, National Park Service, U.S. Department of the Interior, 1988.*

---

## Visually Examining the Mortar and the Masonry Units

A simple *in situ* comparison will help determine the hardness and condition of the mortar and the masonry units. Begin by scraping the mortar with a screwdriver, and gradually tapping harder with a cold chisel and mason's hammer. Masonry units can be tested in the same way beginning, even more gently, by scraping with a fingernail. This relative analysis which is derived from the 10-point hardness scale used to describe minerals, provides a good starting point for selection of an appropriate mortar. It is described more fully in "The Russack System for Brick & Mortar Description" referenced in **Selected Reading** at the end of this Brief.

Mortar samples should be chosen carefully, and picked from a variety of locations on the building to find unweathered mortar, if possible. Portions of the building may have been repointed in the past while other areas may be subject to conditions causing unusual deterioration. There may be several colors of mortar dating from different construction periods or sand used from different sources during the initial construction. Any of these situations can give false readings to the visual or physical characteristics required for the new mortar. Variations should be noted which may require developing more than one mix.

1) Remove with a chisel and hammer three or four unweathered samples of the mortar to be matched from several locations on the building. (Set the largest sample aside--this will be used later for comparison with the repointing mortar). Removing a full representation of samples will allow selection of a "mean" or average mortar sample.

2) Mash the remaining samples with a wooden mallet, or hammer if necessary, until they are separated into their constituent parts. There should be a good handful of the material.

3) Examine the powdered portion--the lime and/or cement matrix of the mortar. Most particularly, note the color. There is a tendency to think of historic mortars as having white binders, but grey portland cement was available by the last quarter of the 19th century, and traditional limes were also sometimes grey. Thus, in some instances, the natural color of the historic binder may be grey, rather than white. The mortar may also have been tinted to create a colored mortar, and this color should be identified at this point.

4) Carefully blow away the powdery material (the lime and/or cement matrix which bound the mortar together).

5) With a low power (10 power) magnifying glass, examine the remaining sand and other materials such as lumps of lime or shell.

6) Note and record the wide range of color as well as the varying sizes of the individual grains of sand, impurities, or other materials.

## **Other Factors to Consider**

**Color.** Regardless of the color of the binder or colored additives, the sand is the primary material that gives mortar its color. A surprising variety of colors of sand may be found in a single sample of historic mortar, and the different sizes of the grains of sand or other materials, such as incompletely ground lime or cement, play an important role in the texture of the repointing mortar. Therefore, when specifying sand for repointing

mortar, it may be necessary to obtain sand from several sources and to combine or screen them in order to approximate the range of sand colors and grain sizes in the historic mortar sample.

**Pointing Style.** Close examination of the historic masonry wall and the techniques used in the original construction will assist in maintaining the visual qualities of the building. Pointing styles and the methods of producing them should be examined. It is important to look at both the horizontal and the vertical joints to determine the order in which they were tooled and whether they were the same style. Some late-19th and early-20th century buildings, for example, have horizontal joints that were raked back while the vertical joints were finished flush and stained to match the bricks, thus creating the illusion of horizontal bands. Pointing styles may also differ from one facade to another; front walls often received greater attention to mortar detailing than side and rear walls. **Tuckpointing** is not true repointing but the application of a raised joint or lime putty joint on top of flush mortar joints. **Penciling** is a purely decorative, painted surface treatment over a mortar joint, often in a contrasting color.

**Masonry Units.** The masonry units should also be examined so that any replacement units will match the historic masonry. Within a wall there may be a wide range of colors, textures, and sizes, particularly with hand-made brick or rough-cut, locally-quarried stone. Replacement units should blend in with the full range of masonry units rather than a single brick or stone.

### Matching Color and Texture of the Repointing Mortar

New mortar should match the unweathered interior portions of the historic mortar. The simplest way to check the match is to make a small sample of the proposed mix and allow it to cure at a temperature of approximately 70 degrees F for about a week, or it can be baked in an oven to speed up the curing; this sample is then broken open and the surface is compared with the surface of the largest "saved" sample of historic mortar.

If a proper color match cannot be achieved through the use of natural sand or colored aggregates like crushed marble or brick dust, it may be necessary to use a modern mortar pigment.

During the early stages of the project, it should be determined how closely the new mortar should match the historic mortar. Will "quite close" be sufficient, or is "exactly" expected? The specifications should state this clearly so that the contractor has a reasonable idea how much time and expense will be required to develop an acceptable match.

The same judgment will be necessary in matching replacement terra cotta, stone or brick. If there is a known source for replacements, this should be included in the specifications. If a source cannot be determined prior to the bidding process, the specifications should include an estimated price for the replacement materials with the final price based on the actual cost to the contractor.

<b>Mortar Types</b> (Measured by volume)			
Designation	Cement	Hydrated Lime	Sand

		or Lime Putty	
M	1	1/4	3 - 3 3/4
S	1	1/2	4 - 4 1/2
N	1	1	5 - 6
O	1	2	8 - 9
K	1	3	10 - 12
"L"	0	1	2 1/4 - 3

Suggested Mortar Types for Different Exposures			
Masonry Material	Exposure		
	Sheltered	Moderate	Severe
Very durable: granite, hard-cored brick, etc.	O	N	S
Moderately durable: limestone, durable stone, molded brick	K	O	N
Minimally durable: soft hand-made brick	"L"	K	O

## Summary

**For the Owner/Administrator.** The owner or administrator of a historic building should remember that repointing is likely to be a lengthy and expensive process. First, there must be adequate time for evaluation of the building and investigation into the cause of problems. Then, there will be time needed for preparation of the contract documents. The work itself is precise, time-consuming and noisy, and scaffolding may cover the face of the building for some time. Therefore, the owner must carefully plan the work to avoid problems. Schedules for both repointing and other activities will thus require careful coordination to avoid unanticipated conflicts. The owner must avoid the tendency to rush the work or cut corners if the historic building is to retain its visual integrity and the job is to be durable.

**For the Architect/Consultant.** Because the primary role of the consultant is to ensure the life of the building, a knowledge of historic construction techniques and the special problems found in older buildings is essential. The consultant must assist the owner in planning for logistical problems relating to research and construction. It is the consultant's responsibility to determine the cause of the mortar deterioration and ensure that it is corrected before the masonry is repointed. The consultant must also be prepared to spend more time in project inspections than is customary in modern construction.

**For the Masons.** Successful repointing depends on the masons themselves. Experienced masons understand the special requirements for work on historic buildings and the added time and expense they require. The entire masonry crew must be willing and able to perform the work in conformance with the specifications, even when the specifications may not be in conformance with standard practice. At the same time, the masons should not hesitate to question the specifications if it appears that the work

specified would damage the building.

---

## Conclusion

A good repointing job is meant to last, at least 30 years, and preferably 50- 100 years. Shortcuts and poor craftsmanship result not only in diminishing the historic character of a building, but also in a job that looks bad, and will require future repointing sooner than if the work had been done correctly. The mortar joint in a historic masonry building has often been called a wall's "first line of defense." Good repointing practices guarantee the long life of the mortar joint, the wall, and the historic structure. Although careful maintenance will help preserve the freshly repointed mortar joints, it is important to remember that mortar joints are intended to be sacrificial and will probably require repointing some time in the future. Nevertheless, if the historic mortar joints proved durable for many years, then careful repointing should have an equally long life, ultimately contributing to the preservation of the entire building.

## Selected Reading

Ashurst, John & Nicola. *Practical Building Conservation. Vol. 3: Mortars, Plasters and Renders*. New York: Halsted Press, a Division of John Wiley & Sons, Inc., 1988.

Cliver, E. Blaine. "Tests for the Analysis of Mortar Samples." *Bulletin of the Association for Preservation Technology*. Vol. 6, No. 1 (1974), pp. 68-73.

Coney, William B., AIA. *Masonry Repointing of Twentieth-Century Buildings*. Illinois Preservation Series. Number 10. Springfield, IL: Division of Preservation Services, Illinois Historic Preservation Agency, 1989.

Davidson, J.I. "Masonry Mortar." *Canadian Building Digest*. CBD 163. Ottawa, ONT: Division of Building Research, National Research Council of Canada, 1974.

Ferro, Maximillian L., AIA, RIBA. "The Russack System for Brick and Mortar Description: A Field Method for Assessing Masonry Hardness." *Technology and Conservation*. Vol. 5, No. 2 (Summer 1980), pp. 32-35.

Hooker, Kenneth A. "Field Notes on Repointing." *Aberdeen's Magazine of Masonry Construction*. Vol. 4, No. 8 (August 1991), pp. 326-328.

Jedrzejska, H. "Old Mortars in Poland: A New Method of Investigation." *Studies in Conservation*. Vol. 5, No. 4 (1960), pp. 132-138.

"Lime's Role in Mortar." *Aberdeen's Magazine of Masonry Construction*. Vol. 9, No. 8 (August 1996), pp. 364-368.

Phillips, Morgan W. "Brief Notes on the Subjects of Analyzing Paints and Mortars and the Recording of Moulding Profiles: The Trouble with Paint and Mortar Analysis." *Bulletin of the Association for Preservation Technology*. Vol. 10, No. 2 (1978), pp. 77-89.

*Preparation and Use of Lime Mortars: An Introduction to the Principles of Using Lime Mortars.* Scottish Lime Centre for Historic Scotland. Edinburgh: Historic Scotland, 1995.

Schierhorn, Carolyn. "Ensuring Mortar Color Consistency." *Aberdeen's Magazine of Masonry Construction*. Vol. 9, No. 1 (January 1996), pp. 33-35.

"Should Air-Entrained Mortars Be Used?" *Aberdeen's Magazine of Masonry Construction*. Vol. 7, No. 9 (September 1994), pp. 419-422.

Sickels-Taves, Lauren B. "Creep, Shrinkage, and Mortars in Historic Preservation." *Journal of Testing and Evaluation, JTEVA*. Vol. 23, No. 6 (November 1995), pp. 447-452.

Speweik, John P. *The History of Masonry Mortar in America, 1720-1995*. Arlington, VA: National Lime Association, 1995.

Speweik, John P. "Repointing Right: Why Using Modern Mortar Can Damage a Historic House." *Old-House Journal*. Vol. XXV, No. 4 (July-August 1997), pp. 46-51.

*Technical Notes on Brick Construction*. Brick Institute of America, Reston, VA.

"Moisture Resistance of Brick Masonry: Maintenance." 7F. February 1986.

"Mortars for Brick Masonry." 8 Revised II. November 1989.

"Standard Specification for Portland Cement-Lime Mortar for Brick Masonry." 8A Revised. September 1988.

"Mortar for Brick Masonry-Selection and Controls." 8B Reissued. September 1988. (July/August 1976).

"Guide Specifications for Brick Masonry, Part V Mortar and Grout." 11E Revised. September 1991.

"Bonds and Patterns in Brickwork." 30 Reissued. September 1988.

## **Useful Addresses**

Brick Institute of America  
11490 Commerce Park Drive  
Reston, VA 22091

National Lime Association  
200 N. Glebe Road, Suite 800  
Arlington, VA 22203

Portland Cement Association  
5420 Old Orchard Road  
Skokie, IL 60077

---

## Acknowledgments

**Robert C. Mack, FAIA**, is a principal in the firm of MacDonald & Mack, Architects, Ltd., an architectural firm that specializes in historic buildings in Minneapolis, Minnesota. **John P. Speweik, CSI**, Toledo, Ohio, is a 5th-generation stonemason, and principal in U.S. Heritage Group, Inc., Chicago, Illinois, which does custom historic mortar matching. **Anne Grimmer**, Senior Architectural Historian, Heritage Preservation Services Program, National Park Service, was responsible for developing and coordinating the revision of this Preservation Brief, incorporating professional comments, and the technical editing.

The authors and the editor wish to thank the following for the professional and technical review they provided: Mark Macpherson and Ron Peterson, Masonry Restoration Contractors, Macpherson-Towne Company, Minneapolis, MN; Lorraine Schnabel, Architectural Conservator, John Milner Associates, Inc., Philadelphia, PA; Lauren B. Sickels-Taves, Ph.D., Architectural Conservator, Biohistory International, Huntington Woods, MI; and the following National Park Service professional staff, including: E. Blaine Cliver, Chief, Historic American Buildings Survey/Historic American Engineering Record; Douglas C. Hicks, Deputy Superintendent, Historic Preservation Training Center, Frederick, MD; Chris McGuigan, Supervisory Exhibits Specialist, Historic Preservation Training Center, Frederick, MD; Charles E. Fisher, Sharon C. Park, FAIA, John Sandor, Technical Preservation Services Branch, Heritage Preservation Services, and Kay D. Weeks, Heritage Preservation Services.

The original version of this brief, *Repointing Mortar Joints in Historic Brick Buildings*, was written by Robert C. Mack in 1976, and was revised and updated in 1980 by Robert C. Mack, de Teel Patterson Tiller, and James S. Askins.

**Washington, D.C. October, 1998**

**Home page logo: Soft mortar for repointing. Photo: John P. Speweik.**

---

*This publication has been prepared pursuant to the National Historic Preservation Act of 1966, as amended, which directs the Secretary of the Interior to develop and make available information concerning historic properties. Technical Preservation Services (TPS), Heritage Preservation Services Division, National Park Service prepares standards, guidelines, and other educational materials on responsible historic preservation treatments for a broad public.*

---

# 6



Undamaged historic brick (above). Sandblasted brick (below). Photo: Courtesy, Illinois Historic Preservation Agency.

## Dangers of Abrasive Cleaning to Historic Buildings

Anne E. Grimmer

- [What is Abrasive Cleaning?](#)
- [Why are Abrasive Cleaning Methods Used?](#)
- [Problems of Abrasive Cleaning](#)
- [How Building Materials React to Abrasive Cleaning](#)
- [When is Abrasive Cleaning Permissible?](#)
- [Do Not Abrasively Clean these Historic Interiors](#)
- [Mitigating the Effects of Abrasive Cleaning](#)
- [Summary and References](#)
- [Reading List](#)
- [Download the PDF](#)

“Chemical or physical treatments, such as sandblasting, that cause damage to historic materials shall not be used. The surface cleaning of structures, if appropriate, shall be undertaken using the gentlest means possible.” —**The Secretary of the Interior's Standards for Rehabilitation.**

**Abrasive cleaning methods are responsible for causing a great deal of damage to historic building materials.** To prevent indiscriminate use of these potentially harmful techniques, this brief has been prepared to explain abrasive cleaning methods, how they can be physically and aesthetically destructive to historic building materials, and why they generally are not acceptable preservation treatments for historic structures. There are alternative, less harsh means of cleaning and removing paint and stains from historic buildings. However, careful testing should precede general cleaning to assure that the method selected will not have an adverse effect on the building materials. A historic building is irreplaceable, and should be cleaned using only the "gentlest means possible" to best preserve it.

### **What is Abrasive Cleaning?** [return to top ▲](#)



Abrasive cleaning can cause permanent damage to historic fabric, such as this brick wall. Photo: NPS files.

Abrasive cleaning methods include all techniques that physically abrade the building surface to remove soils, discolorations or coatings. Such techniques involve the use of certain *materials* which impact or abrade the surface under pressure, or abrasive *tools and equipment*. Sand, because it is readily available, is probably the most commonly used type of grit material. However, any of the following materials may be substituted for sand, and all can be classified as abrasive substances: ground slag or volcanic ash, crushed (pulverized) walnut or almond shells, rice husks, ground corncobs, ground coconut shells, crushed eggshells, silica flour, synthetic particles, glass beads and micro-balloons. Even *water* under pressure can be an abrasive substance. Tools and equipment that are abrasive to historic building materials include wire brushes, rotary wheels, power sanding disks and belt sanders.

The use of water in combination with grit may also be classified as an abrasive cleaning method. Depending on the manner in which it is applied, water may soften the impact of the grit, but water that is too highly pressurized can be very abrasive. There are basically two different methods which can be referred to as "wet grit," and it is important to differentiate between the two. One technique involves the addition of a stream of water to a regular sandblasting nozzle. This is done primarily to cut down dust, and has very little, if any, effect on reducing the aggressiveness, or cutting action of the grit particles. With the second technique, a very small amount of grit is added to a pressurized water stream. This method may be controlled by regulating the amount of grit fed into the water stream, as well as the pressure of the water.

## Why Are Abrasive Cleaning Methods Used? [return to](#)

[top ▲](#)

Usually, an abrasive cleaning method is selected as an expeditious means of quickly removing years of dirt accumulation, unsightly stains, or deteriorating building fabric or finishes, such as stucco or paint.



Brick molding next to the window has been severely abraded by sandblasting to remove paint. Photo: NPS files.

The fact that sandblasting is one of the best known and most readily available building cleaning treatments is probably the major reason for its frequent use.

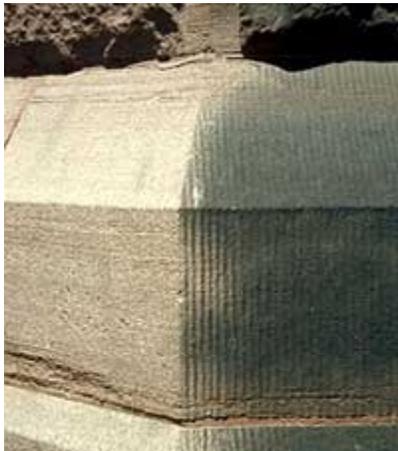
Many mid-19th century brick buildings were painted immediately or soon after completion to protect poor quality brick or to imitate another material, such as stone. Sometimes brick buildings were painted in an effort to produce what was considered a more harmonious relationship between a building and its natural surroundings. By the 1870s, brick buildings were often left unpainted as mechanization in the brick industry brought a cheaper pressed brick and fashion decreed a sudden preference for dark colors. However, it was still customary to paint brick of poorer quality for the additional protection the paint afforded.

It is a common 20th century misconception that all historic masonry buildings were initially unpainted. If the intent of a modern restoration is to return a building to its original appearance, removal of the paint not only may be historically inaccurate, but also harmful. Many older buildings were painted or stuccoed at some point to correct recurring maintenance problems caused by faulty construction techniques, to hide alterations, or in an attempt to solve moisture problems. If this is the case, removal of paint or stucco may cause these problems to reoccur.

Another reason for paint removal, particularly in rehabilitation projects, is to give the building a "new image" in response to contemporary design trends and to attract investors or tenants. Thus, it is necessary to consider the purpose of the intended cleaning. While it is clearly important to remove unsightly stains, heavy encrustations of dirt, peeling paint or other surface coatings, it may not be equally desirable to remove paint from a building which originally was painted. Many historic buildings which show only a slight amount of soil or discoloration are much better left as they are.

A thin layer of soil is more often protective of the building fabric than it is harmful, and seldom detracts from the building's architectural and/or historic character. Too thorough cleaning of a historic building may not only sacrifice some of the building's character, but also, misguided cleaning efforts can cause a great deal of damage to historic building fabric. Unless there are stains, graffiti or dirt and pollution deposits which are destroying the building fabric, it is generally preferable to do as little cleaning as possible, or to repaint where necessary. It is important to remember that a historic building does not have to look as if it were newly constructed to be an attractive or successful restoration or rehabilitation project.

## Problems of Abrasive Cleaning [return to top ▲](#)



On the left, grit blasting has obliterated the vertical tooling marks from granite, a very dense stone. Photo: NPS files.

The crux of the problem is that abrasive cleaning is just that--abrasive. An abrasively cleaned historic structure may be physically as well as aesthetically damaged. Abrasive methods "clean" by eroding dirt or paint, but at the same time they also tend to erode the surface of the building material. In this way, abrasive cleaning is destructive and causes irreversible harm to the historic building fabric. If the fabric is brick, abrasive methods remove the hard, outer protective surface, and therefore make the brick more susceptible to rapid weathering and deterioration.

Grit blasting may also increase the water permeability of a brick wall. The impact of the grit particles tends to erode the bond between the mortar and the brick, leaving cracks or enlarging existing cracks where water can enter. Some types of stone develop a protective patina or "quarry crust" parallel to the worked surface (created by the movement of moisture towards the outer edge), which also may be damaged by abrasive cleaning. The rate at which the material subsequently weathers depends on the quality of the inner surface that is exposed. Abrasive cleaning can destroy, or substantially diminish, decorative detailing on buildings such as a molded brickwork or architectural terra-cotta, ornamental carving on wood or stone, and evidence of historic craft techniques, such as tool marks and other surface textures. In addition, perfectly sound and/or "tooled" mortar joints can be worn away by abrasive techniques. This not only results in the loss of historic craft detailing but also requires repointing, a step involving considerable time, skill and expense, and which might not have been necessary had a gentler method been chosen. Erosion and pitting of the building material by abrasive cleaning creates a greater surface area on which dirt and pollutants collect. In this sense, the building fabric "attracts" more dirt, and will require more frequent cleaning in the future. In addition to causing physical and aesthetic harm to the historic fabric, there are several adverse environmental effects of dry abrasive cleaning methods. Because of the friction caused by the abrasive medium hitting the building fabric, these techniques usually create a considerable amount of dust, which is unhealthy, particularly to the operators of the abrasive equipment. It further pollutes the environment around the job site, and deposits dust on neighboring buildings, parked vehicles and nearby trees and shrubbery. Some adjacent materials not intended for abrasive treatment such as wood or glass, may also be damaged because the equipment may be difficult to regulate.

Wet grit methods, while eliminating dust, deposit a messy slurry on the ground or other objects surrounding the base of the building. In colder climates where there is the threat of frost, any wet cleaning process applied to historic masonry structures must be done in warm weather, allowing ample time for the wall to dry out thoroughly before cold weather sets in. Water which remains and freezes in cracks and openings of the masonry surface eventually may lead to spalling. High-pressure wet cleaning may force an inordinate amount of water into the walls, affecting interior materials such as plaster or joist ends, as well as metal building components within the walls.

### **Variable Factors**

The greatest problem in developing practical guidelines for cleaning any historic building is the large number of variable and unpredictable factors involved. Because these variables make each cleaning project unique, it is difficult to establish specific standards at this time. This is particularly true of abrasive cleaning methods because their inherent potential for causing damage is multiplied by the following factors:

- the type and condition of the material being cleaned
- the size and sharpness of the grit particles or the mechanical equipment
- the pressure with which the abrasive grit or equipment is applied to the building surface
- the skill and care of the operator, and
- the constancy of the pressure on all surfaces during the cleaning process.

**Pressure:** The damaging effects of most of the variable factors involved in abrasive cleaning are self evident. However, the matter of pressure requires further explanation. In cleaning specifications, pressure is generally abbreviated as "psi" (pounds per square inch), which technically refers to the "tip" pressure, or the amount of pressure at the nozzle of the blasting apparatus. Sometimes "psig," or pressure at the gauge (which may be many feet away, at the other end of the hose), is used in place of "psi." These terms are often incorrectly used interchangeably.

Despite the apparent care taken by most architects and building cleaning contractors to prepare specifications for pressure cleaning which will not cause harm to the delicate fabric of a historic building, it is very difficult to ensure that the same amount of pressure is applied to all parts of the building. For example, if the operator of the pressure equipment stands on the ground while cleaning a two-story structure, the amount of force reaching the first story will be greater than that hitting the second story, even if the operator stands on scaffolding or in a cherry picker,

because of the "line drop" in the distance from the pressure source to the nozzle. Although technically it may be possible to prepare cleaning specifications with tight controls that would eliminate all but a small margin of error, it may not be easy to find professional cleaning firms willing to work under such restrictive conditions. The fact is that many professional building cleaning firms do not really understand the extreme delicacy of historic building fabric, and how it differs from modern construction materials. Consequently, they may accept building cleaning projects for which they have no experience.



Bronze statuary may be cleaned gently using crushed walnut shells. Photo: NPS files.

The amount of pressure used in any kind of cleaning treatment which involves pressure, whether it is dry or wet grit, chemicals or just plain water, is crucial to the outcome of the cleaning project. Unfortunately, no standards have been established for determining the correct pressure for cleaning each of the many historic building materials which would not cause harm. The considerable discrepancy between the way the building cleaning industry and architectural conservators define "high" and "low" pressure cleaning plays a significant role in the difficulty of creating standards.

**Non-historic/Industrial:** A representative of the building cleaning industry might consider "high" pressure water cleaning to be anything over 5,000 psi, or even as high as 10,000 to 15,000 psi! Water under this much pressure may be necessary to clean industrial structures or machinery, but would destroy most historic building materials. Industrial chemical cleaning commonly utilizes pressures between 1,000 and 2,500 psi.

**Historic:** By contrast, conscientious dry or wet abrasive cleaning of a historic structure would be conducted within the range of 20 to 100 psi at a range of 3 to 12 inches. Cleaning at this low pressure requires the use of a very fine 00 or 0 mesh grit forced through a nozzle with a 1/4-inch opening. A similar, even more delicate method being adopted by architectural conservators uses a micro-abrasive grit on small, hard-to-clean areas of carved, cut or molded ornament on a building facade. Originally developed by museum conservators for cleaning sculpture, this technique may employ glass beads, micro-balloons, or another type of micro-abrasive gently powered at approximately 40 psi by a very small, almost pencil-like pressure instrument. Although a slightly larger pressure instrument may be used on historic buildings, this technique still has limited practical applicability on a large scale building cleaning project because of the cost and the relatively few technicians competent to handle the task. In general, architectural conservators have determined that only through very controlled conditions can most historic building material be abrasively cleaned of soil or paint without measurable damage to the surface or profile of the substrate.

Yet some professional cleaning companies which specialize in cleaning historic masonry buildings use chemicals and water at a pressure of approximately 1,500 psi, while other cleaning firms recommend lower pressures ranging from 200 to 800 psi for a similar project. An architectural conservator might decide, after testing, that some historic structures could be cleaned properly using a moderate pressure (200-600 psi), or even a high pressure (600-1800 psi) water rinse. However, cleaning historic buildings under such high pressure should be considered an exception

rather than the rule, and would require *very careful* testing and supervision to assure that the historic surface materials could withstand the pressure without gouging, pitting or loosening. These differences in the amount of pressure used by commercial or industrial building cleaners and architectural conservators point to one of the main problems in using abrasive means to clean historic buildings: misunderstanding of the potentially fragile nature of historic building materials. There is no one cleaning formula or pressure suitable for all situations. Decisions regarding the proper cleaning process for historic structures can be made only after careful analysis of the building fabric, and testing.

## How Building Materials React to Abrasive Cleaning [return to top ▲](#)

**Brick and Architectural Terra-cotta:** Abrasive blasting does not affect all building materials to the same degree. Such techniques quite logically cause greater damage to softer and more porous materials, such as brick or architectural terra-cotta. When these materials are cleaned abrasively, the hard, outer layer (closest to the heat of the kiln) is eroded, leaving the soft, inner core exposed and susceptible to accelerated weathering. Glazed architectural terra-cotta and ceramic veneer have a baked on glaze which is also easily damaged by abrasive cleaning. Glazed architectural terra-cotta was designed for easy maintenance, and generally can be cleaned using detergent and water; but chemicals or steam may be needed to remove more persistent stains. Large areas of brick or architectural terra-cotta which have been painted are best left painted, or repainted if necessary.

**Plaster and Stucco:** Plaster and stucco are types of masonry finish materials that are softer than brick or terra-cotta; if treated abrasively these materials will simply disintegrate. Indeed, when plaster or stucco is treated abrasively it is usually with the intention of removing the plaster or stucco from whatever base material or substrate it is covering. Obviously, such abrasive techniques should not be applied to clean sound plaster or stuccoed walls, or decorative plaster wall surfaces.

**Building Stones:** Building stones are cut from the three main categories of natural rock: dense, igneous rock such as granite; sandy, sedimentary rock such as limestone or sandstone; and crystalline, metamorphic rock such as marble. As opposed to kiln-dried masonry materials such as brick and architectural terra-cotta, building stones are generally homogeneous in character at the time of a building's construction. However, as the stone is exposed to weathering and environmental pollutants, the surface may become friable, or may develop a protective skin or patina. These outer surfaces are very susceptible to damage by abrasive or improper chemical cleaning.



Very high-pressure water has scarred this granite. Photo: NPS files.

Building stones are frequently cut into ashlar blocks or "dressed" with tool marks that give the building surface a specific texture and contribute to its historic character as much as ornately carved decorative stonework. Such detailing is easily damaged by abrasive cleaning techniques; the pattern of tooling or cutting is erased, and the crisp lines of moldings or carving are worn or pitted.

Occasionally, it may be possible to clean small areas of rough-cut granite, limestone or sandstone having a heavy dirt encrustation by using the "wet grit" method, whereby a small amount of abrasive material is injected into a controlled, pressurized water stream. However, this technique requires very careful supervision in order to prevent damage to the stone. Polished or honed marble or granite should never be treated abrasively, as the abrasion would remove the finish in much the way glass would be etched or "frosted" by such a process. It is generally preferable to underclean, as too strong a cleaning procedure will erode the stone, exposing a new and increased surface area to collect atmospheric moisture and dirt. Removing paint, stains or graffiti from most types of stone may be accomplished by a chemical treatment carefully selected to best handle the removal of the particular type of paint or stain without damaging the stone. (See section on the "Gentlest Means Possible.")

**Wood:** Most types of wood used for buildings are soft, fibrous and porous, and are particularly susceptible to damage by abrasive cleaning. Because the summer wood between the lines of the grain is softer than the grain itself, it will be worn away by abrasive blasting or power tools, leaving an uneven surface with the grain raised and often frayed or "fuzzy." Once this has occurred, it is almost impossible to achieve a smooth surface again except by extensive hand sanding, which is expensive and will quickly negate any costs saved earlier by sandblasting. Such harsh cleaning treatment also obliterates historic tool marks, fine carving and detailing, which precludes its use on any interior or exterior woodwork which has been hand planed, milled or carved.

**Metals:** Like stone, metals are another group of building materials which vary considerably in hardness and durability. Softer metals which are used architecturally, such as tin, zinc, lead, copper or aluminum, generally should not be cleaned abrasively as the process deforms and destroys the original surface texture and appearance, as well as the acquired patina.



Decorative pressed metal interior or exterior features should not be cleaned abrasively. Photo: NPS files.

Much applied architectural metal work used on historic buildings--tin, zinc, lead and copper--is often quite thin and soft, and therefore susceptible to denting and pitting. Galvanized sheet metal is especially vulnerable, as abrasive treatment would wear away the protective galvanized layer.

In the late 19th and early 20th centuries, these metals were often cut, pressed or otherwise shaped from sheets of metal into a wide variety of practical uses such as roofs, gutters and flashing, and facade ornamentation such as cornices, friezes, dormers, panels, cupolas, oriel windows, etc. The architecture of the 1920s and 1930s made use of metals such as chrome, nickel alloys, aluminum and stainless steel in decorative exterior panels, window frames, and doorways. Harsh abrasive blasting would destroy the original surface finish of most of these metals, and would increase the possibility of corrosion.

However, conservation specialists are now employing a sensitive technique of glass bead peening to clean some of the harder metals, in particular large bronze outdoor sculpture. Very fine (75125 micron) glass beads are used at a low pressure of 60 to 80 psi. Because these glass beads are completely spherical, there are no sharp edges to cut the surface of the metal. After cleaning, these statues undergo a lengthy process of polishing. Coatings are applied which protect the surface from corrosion, but they must be renewed every 3 to 5 years. A similarly

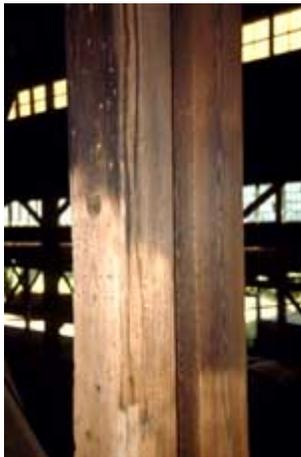
delicate cleaning technique employing glass beads has been used in Europe to clean historic masonry structures without causing damage. But at this time the process has not been tested sufficiently in the United States to recommend it as a building conservation measure. Sometimes a very fine smooth sand is used at a low pressure to clean or remove paint and corrosion from copper flashing and other metal building components. Restoration architects recently found that a mixture of crushed walnut shells and copper slag at a pressure of approximately 200 psi was the only way to remove corrosion successfully from a mid-19th century terne-coated iron roof. Metal cleaned in this manner must be painted immediately to prevent rapid recurrence of corrosion. It is thought that these methods "work harden" the surface by compressing the outer layer, and actually may be good for the surface of the metal. But the extremely complex nature and the time required by such processes make it very expensive and impractical for large-scale use at this time.



Cast iron may be abrasively cleaned, but must be painted immediately to prevent rust. Photo: NPS files.

Cast and wrought iron architectural elements may be gently sandblasted or abrasively cleaned using a wire brush to remove layers of paint, rust and corrosion. Sandblasting was, in fact, developed originally as an efficient maintenance procedure for engineering and industrial structures and heavy machinery--iron and steel bridges, machine tool frames, engine frames, and railroad rolling stock--in order to clean and prepare them for repainting. Because iron is hard, its surface, which is naturally somewhat uneven, will not be noticeably damaged by controlled abrasion. Such treatment will, however, result in a small amount of pitting. But this slight abrasion creates a good surface for paint, since the iron must be repainted immediately to prevent corrosion. Any abrasive cleaning of metal building components will also remove the caulking from joints and around other openings. Such areas must be recaulked quickly to prevent moisture from entering and rusting the metal, or causing deterioration of other building fabric inside the structure.

## When is Abrasive Cleaning Permissible? [return to top ▲](#)



Industrial interiors that are not finely milled may be abrasively cleaned, in some instances. Photo: NPS files.

For the most part, abrasive cleaning is destructive to historic building materials. A limited number of special cases have been explained when it may be appropriate, if supervised by a skilled conservator, to use a delicate abrasive technique on some historic building materials. The type of "wet grit" cleaning which involves a small amount of grit injected into a stream of low pressure water may be used on small areas of stone masonry (i.e., rough cut limestone, sandstone or unpolished granite), where milder cleaning methods have not been totally successful in removing harmful deposits of dirt and pollutants. Such areas may include stone window sills, the tops of cornices or column capitals, or other detailed areas of the facade. This is still an abrasive technique, and without proper caution in handling, it can be *just as harmful to the building surface as any other abrasive cleaning method*. Thus, the decision to use this type of "wet grit" process should be made only after consultation with an experienced building conservator. *Remember that it is very time consuming and expensive to use any abrasive technique on a historic building in such a manner that it does not cause harm to the often fragile and friable building materials.*

At this time, and only under certain circumstances, abrasive cleaning methods may be used in the rehabilitation of interior spaces of warehouse or industrial buildings for contemporary uses. Interior spaces of factories or warehouse structures in which the masonry or plaster surfaces do not have significant design, detailing, tooling or finish, and in which wooden architectural features are not finished, molded, beaded or worked by hand, may be cleaned abrasively in order to remove layers of paint and industrial discolorations such as smoke, soot, etc. It is expected after such treatment that brick surfaces will be rough and pitted, and wood will be somewhat frayed or "fuzzy" with raised wood grain. These nonsignificant surfaces will be damaged and have a roughened texture, but because they are interior elements, they will not be subject to further deterioration caused by weathering.

## Historic Interiors That Should Not Be Cleaned Abrasively [return to top ▲](#)



Decorative wood exterior or interior features should not be cleaned abrasively. Photo: NPS files.

Those instances (generally industrial and some commercial properties), when it may be acceptable to use an abrasive treatment on the interior of historic structures have been described. But for the majority of historic buildings, the Secretary of the Interior's *Guidelines for Rehabilitation* do not recommend "changing the texture of exposed wooden architectural features (including structural members) and masonry surfaces through sandblasting or use of other abrasive techniques to remove paint, discolorations and plaster.

Thus, it is not acceptable to clean abrasively interiors of historic residential and commercial properties which have *finished* interior spaces featuring milled woodwork such as doors, window and door moldings, wainscoting, stair balustrades and mantelpieces. Even the most modest historic house interior, although it may not feature elaborate detailing, contains plaster and woodwork that is architecturally significant to the original design and function of the house. Abrasive cleaning of such an interior would be destructive to the historic integrity of the building. Abrasive cleaning is also impractical. Rough surfaces of abrasively cleaned wooden elements are hard to keep clean. It is also difficult to seal, paint or maintain these surfaces which can be splintery and a problem to the building's occupants. The force of abrasive blasting may cause grit particles to lodge in cracks of wooden elements, which will be a nuisance as the grit is loosened

by vibrations and gradually sifts out. Removal of plaster will reduce the thermal and insulating value of the walls. Interior brick is usually softer than exterior brick, and generally of a poorer quality. Removing surface plaster from such brick by abrasive means often exposes gaping mortar joints and mismatched or repaired brickwork which was never intended to show. The resulting bare brick wall may require repointing, often difficult to match. It also may be necessary to apply a transparent surface coating (or sealer) in order to prevent the mortar and brick from "dusting." However, a sealer may not only change the color of the brick, but may also compound any existing moisture problems by restricting the normal evaporation of water vapor from the masonry surface.

### **"Gentlest Means Possible"**

There are alternative means of removing dirt, stains and paint from historic building surfaces that can be recommended as more efficient and less destructive than abrasive techniques. The "gentlest means possible" of removing dirt from a building surface can be achieved by using a low-pressure water wash, scrubbing areas of more persistent grime with a natural bristle (never metal) brush. Steam cleaning can also be used effectively to clean some historic building fabric. Low-pressure water or steam will soften the dirt and cause the deposits to rise to the surface, where they can be washed away.

A third cleaning technique which may be recommended to remove dirt, as well as stains, graffiti or paint, involves the use of commercially available chemical cleaners or paint removers, which, when applied to masonry, loosen or dissolve the dirt or stains. These cleaning agents may be used in combination with water or steam, followed by a clear water wash to remove the residue of dirt and the chemical cleaners from the masonry. A natural bristle brush may also facilitate this type of chemically assisted cleaning, particularly in areas of heavy dirt deposits or stains, and a wooden scraper can be useful in removing thick encrustations of soot. A limewash or absorbent talc, whiting or clay poultice with a solvent can be used effectively to draw out salts or stains from the surface of the selected areas of a building facade. It is almost impossible to remove paint from masonry surfaces without causing some damage to the masonry, and it is best to leave the surfaces as they are or repaint them if necessary.

Some physicists are experimenting with the use of pulsed laser beams and xenon flash lamps for cleaning historic masonry surfaces. At this time it is a slow, expensive cleaning method, but its initial success indicates that it may have an increasingly important role in the future.

There are many chemical paint removers which, when applied to painted wood, soften and dissolve the paint so that it can be scraped off by hand. Peeling paint can be removed from wood by hand scraping and sanding. Particularly thick layers of paint may be softened with a heat gun or heat plate, providing appropriate precautions are taken, and the paint film scraped off by hand. Too much heat applied to the same spot can burn the wood, and the fumes caused by burning paint are dangerous to inhale, and can be explosive. Furthermore, the hot air from heat guns can start fires in the building cavity. Thus, adequate ventilation is important when using a heat gun or heat plate, as well as when using a chemical stripper. A torch or open flame should never be used.

**Preparations for Cleaning:** It cannot be overemphasized that all of these cleaning methods must be approached with caution. When using any of these procedures which involve water or other liquid cleaning agents on masonry, it is imperative that all openings be tightly covered, and all cracks or joints be well pointed in order to avoid the danger of water penetrating the building's facade, a circumstance which might result in serious moisture related problems such as efflorescence and/or subflorescence. Any time water is used on masonry as a cleaning agent, either in its pure state or in combination with chemical cleaners, it is very important that the work be done in warm weather when there is no danger of frost for several months. Otherwise water which has penetrated the masonry may freeze, eventually causing the surface of the building to crack and spall, which may create another conservation problem more serious to the health of the building than dirt.

Each kind of masonry has a unique composition and reacts differently with various chemical cleaning substances. Water and/or chemicals may interact with minerals in stone and cause new types of stains to leach out to the surface immediately, or more gradually in a delayed reaction.

What may be a safe and effective cleaner for certain stain on one type of stone, may leave unattractive discolorations on another stone, or totally dissolve a third type.

**Testing:** Cleaning historic building materials, particularly masonry, is a technically complex subject, and thus, should never be done without expert consultation and testing. No cleaning project should be undertaken without first applying the intended cleaning agent to a representative test patch area in an inconspicuous location on the building surface. The test patch or patches should be allowed to weather for a period of time, preferably through a complete seasonal cycle, in order to determine that the cleaned area will not be adversely affected by wet or freezing weather or any by-products of the cleaning process.

## Mitigating the Effects of Abrasive Cleaning [return to top](#)



There are certain restoration measures which can be adopted to help preserve a historic building exterior which has been damaged by abrasive methods. Wood that has been sandblasted will exhibit a frayed or "fuzzed" surface, or a harder wood will have an exaggerated raised grain. The only way to remove this rough surface or to smooth the grain is by laborious sanding.

Sandblasted wood, unless it has been extensively sanded, serves as a dustcatcher, will weather faster, and will present a continuing and ever worsening maintenance problem. Such wood, after sanding, should be painted or given a clear surface coating to protect the wood, and allow for somewhat easier maintenance.

There are few successful preservative treatments that may be applied to grit-blasted exterior masonry. Harder, denser stone may have suffered only a loss of crisp edges or tool marks, or other indications of craft technique. If the stone has a compact and uniform composition, it should continue to weather with little additional deterioration. But some types of sandstone, marble and limestone will weather at an accelerated rate once their protective "quarry crust" or patina has been removed.

Softer types of masonry, particularly brick and architectural terra-cotta, are the most likely to require some remedial treatment if they have been abrasively cleaned. Old brick, being essentially a soft, baked clay product, is greatly susceptible to increased deterioration when its hard, outer skin is removed through abrasive techniques. This problem can be minimized by painting the brick. An alternative is to treat it with a clear sealer or surface coating but this will give the masonry a glossy, or shiny look. It is usually preferable to paint the brick rather than to apply a transparent sealer since sealers reduce the transpiration of moisture, allowing salts to crystallize as subflorescence that eventually spalls the brick. If a brick surface has been so extensively damaged by abrasive cleaning and weathering that spalling has already begun, it may be necessary to cover the walls with stucco, if it will adhere.

Of course, the application of paint, a clear surface coating (sealer), or stucco to deteriorating masonry means that the historical appearance will be sacrificed in an attempt to conserve the historic building materials. However, the original color and texture will have been changed already by the abrasive treatment. At this point it is more important to try to preserve the brick, and there is little choice but to protect it from "dusting" or spalling too rapidly. As a last resort, in the case of severely spalling brick, there may be no option but to replace the brick--a difficult, expensive (particularly if custom-made reproduction brick is used), and lengthy process. As described earlier, sandblasted interior brick work, while not subject to change of weather, may require the application of a transparent surface coating or painting as a maintenance procedure to contain loose mortar and brick dust. (See [Preservation Briefs No. 1](#) for a more thorough discussion of coatings.)

Metals, other than cast or wrought iron, that have been pitted and dented by harsh abrasive blasting usually cannot be smoothed out. Although fillers may be satisfactory for smoothing a painted surface, exposed metal that has been damaged usually will have to be replaced.

## Summary and References [return to top](#) ▲

Sandblasting or other abrasive methods of cleaning or paint removal are by their nature destructive to historic building materials and should not be used on historic buildings except in a few well-monitored instances. There are exceptions when certain types of abrasive cleaning may

be permissible, but only if conducted by a trained conservator, and if cleaning is necessary for the preservation of the historic structure.

There is no one formula that will be suitable for cleaning all historic building surfaces. Although there are many commercial cleaning products and methods available, it is impossible to state definitively which of these will be the most effective without causing harm to the building fabric. It is often difficult to identify ingredients or their proportions contained in cleaning products; consequently it is hard to predict how a product will react to the building materials to be cleaned. Similar uncertainties affect the outcome of other cleaning methods as they are applied to historic building materials. Further advances in understanding the complex nature of the many variables of the cleaning techniques may someday provide a better and simpler solution to the problems. But until that time, the process of cleaning historic buildings must be approached with caution through trial and error.

It is important to remember that historic building materials are neither indestructible, nor are they renewable. They must be treated in a responsible manner, which may mean little or no cleaning at all if they are to be preserved for future generations to enjoy. If it is in the best interest of the building to clean it, then it should be done "using the gentlest means possible."

### **Acknowledgements**

This Preservation Brief was written by **Anne E. Grimmer**, Architectural Historian, Technical Preservation Services Division. Valuable suggestions and comments were made by Hugh C. Miller, AIA, Washington, D.C.; Martin E. Weaver, Ottawa, Ontario, Canada; Terry Bryant, Downers Grove, Illinois; Daniel C. Cammer, McLean, Virginia; and the professional staff of Technical Preservation Services Division. Deborah Cooney edited the final manuscript.

The illustrations for this brief not specifically credited are from the files of the Technical Preservation Services Division.

This publication has been prepared pursuant to the National Historic Preservation Act of 1966, as amended, which directs the Secretary of the Interior to develop and make available information concerning historic properties. Technical Preservation Services (TPS), National Park Service prepares standards, guidelines, and other educational materials on responsible historic preservation treatments for a broad public.

June 1979

# Statement of Special Inspections

---

Project: *CITY CLUBHOUSE*

Location: *696 SENECA STREET BUFFALO, NY*

Owner:

Design Professional in Responsible Charge: *PETRILLI STRUCTURAL AND CONSULTING ENG. PC*

This *Statement of Special Inspections* is submitted as a condition for permit issuance in accordance with the Special Inspection and Structural Testing requirements of the Building Code. It includes a schedule of Special Inspection services applicable to this project as well as the name of the Special Inspection Coordinator and the identity of other approved agencies to be retained for conducting these inspections and tests. This *Statement of Special Inspections* encompass the following disciplines:

- Structural                       Mechanical/Electrical/Plumbing  
 Architectural                       Other: \_\_\_\_\_

The Special Inspection Coordinator shall keep records of all inspections and shall furnish inspection reports to the Building Official and the Registered Design Professional in Responsible Charge. Discovered discrepancies shall be brought to the immediate attention of the Contractor for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and the Registered Design Professional in Responsible Charge. The Special Inspection program does not relieve the Contractor of his or her responsibilities.

Interim reports shall be submitted to the Building Official and the Registered Design Professional in Responsible Charge.

A *Final Report of Special Inspections* documenting completion of all required Special Inspections, testing and correction of any discrepancies noted in the inspections shall be submitted prior to issuance of a Certificate of Use and Occupancy.

Job site safety and means and methods of construction are solely the responsibility of the Contractor.

Interim Report Frequency: *AS NOTED* or  per attached schedule.

Prepared by:

*ARNALDO PETRILLI*

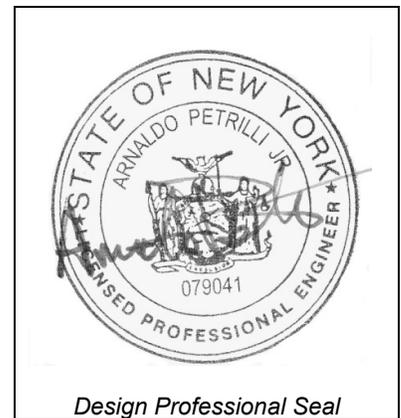
(type or print name)

*Arnaldo Petrilli Jr.*

Signature

*09/19/22*

Date



*Design Professional Seal*

Owner's Authorization:

Building Official's Acceptance:

Signature

Date

Signature

Date

# Schedule of Inspection and Testing Agencies

This Statement of Special Inspections / Quality Assurance Plan includes the following building systems:

- |  |  |
|--|--|
| <input checked="" type="checkbox"/> Soils and Foundations  | <input type="checkbox"/> Spray Fire Resistant Material         |
| <input checked="" type="checkbox"/> Cast-in-Place Concrete | <input checked="" type="checkbox"/> Wood Construction          |
| <input type="checkbox"/> Precast Concrete                  | <input type="checkbox"/> Exterior Insulation and Finish System |
| <input type="checkbox"/> Masonry                           | <input type="checkbox"/> Mechanical & Electrical Systems       |
| <input checked="" type="checkbox"/> Structural Steel       | <input type="checkbox"/> Architectural Systems                 |
| <input type="checkbox"/> Cold-Formed Steel Framing         | <input type="checkbox"/> Special Cases                         |

Special Inspection Agencies	Firm	Address, Telephone, e-mail
1. <b>Special Inspection Coordinator:</b> (Personal Name of Individual Coordinating Inspections)	<i>Petrilli Structural and Consulting PC</i>  Coordinator Name: <i>AJ Petrilli</i>	<i>245 Kinsey Ave Kenmore NY</i> <i>716-854-3508</i> <i>ajpetrilli@petrilliengineering.com</i>
2. Inspection Agency	<i>TBD</i>	
3. Geotechnical Agency	<i>WMA ENGINEERING</i>	<i>5167 SOUTH PARK AVE.</i> <i>BUFFALO NY</i> <i>716-649-8110</i> <i>jdanzers@sjbempire.net</i>
4. Structural Engineer	<i>Petrilli Structural and Consulting PC</i>  Coordinator Name: <i>AJ Petrilli</i>	<i>245 Kinsey Ave Kenmore NY</i> <i>716-854-3508</i> <i>ajpetrilli@petrilliengineering.com</i>
5. Testing Agency	<i>TBD</i>	
6. Other		

Note: The inspectors and testing agencies shall be engaged by the Owner or the Owner's Agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the Building Official, prior to commencing work.

# Quality Assurance Plan

---

## Quality Assurance for Seismic Resistance

Seismic Design Category *B*  
Quality Assurance Plan Required (Y/N) *N*

Description of seismic force resisting system and designated seismic systems:  
*WOOD PANEL SHEAR WALLS*

## Quality Assurance for Wind Requirements

Basic Wind Speed (3 second gust) *109*  
Wind Exposure Category *B*  
Quality Assurance Plan Required (Y/N) *N*

Description of wind force resisting system and designated wind resisting components:  
*WOOD PANEL SHEAR WALLS*

## Statement of Responsibility

Each contractor responsible for the construction or fabrication of a system or component designated above must submit a Statement of Responsibility.

# Qualifications of Inspectors and Testing Technicians

---

The qualifications of all personnel performing Special Inspection and testing activities are subject to the approval of the Building Official. The credentials of all Inspectors and testing technicians shall be provided if requested.

## Key for Minimum Qualifications of Inspection Agents:

When the Registered Design Professional in Responsible Charge deems it appropriate that the individual performing a stipulated test or inspection have a specific certification or license as indicated below, such designation shall appear below the *Agency Number* on the Schedule.

PE/SE	Structural Engineer – a licensed SE or PE specializing in the design of building structures
PE/GE	Geotechnical Engineer – a licensed PE specializing in soil mechanics and foundations
EIT	Engineer-In-Training – a graduate engineer who has passed the Fundamentals of Engineering examination

### American Concrete Institute (ACI) Certification

ACI-CFTT	Concrete Field Testing Technician – Grade 1
ACI-CCI	Concrete Construction Inspector
ACI-LTT	Laboratory Testing Technician – Grade 1&2
ACI-STT	Strength Testing Technician

### American Welding Society (AWS) Certification

AWS-CWI	Certified Welding Inspector
AWS/AISC-SSI	Certified Structural Steel Inspector

### American Society of Non-Destructive Testing (ASNT) Certification

ASNT	Non-Destructive Testing Technician – Level II or III.
------	---

### International Code Council (ICC) Certification

ICC-SMSI	Structural Masonry Special Inspector
ICC-SWSI	Structural Steel and Welding Special Inspector
ICC-SFSI	Spray-Applied Fireproofing Special Inspector
ICC-PCSI	Prestressed Concrete Special Inspector
ICC-RCSI	Reinforced Concrete Special Inspector

### National Institute for Certification in Engineering Technologies (NICET)

NICET-CT	Concrete Technician – Levels I, II, III & IV
NICET-ST	Soils Technician - Levels I, II, III & IV
NICET-GET	Geotechnical Engineering Technician - Levels I, II, III & IV

### Exterior Design Institute (EDI) Certification

EDI-EIFS	EIFS Third Party Inspector
----------	----------------------------

### Other

---

Item	Agency # (Qualif.)	Scope	Inspection Frequency
1. Shallow Foundations	PE/GE	~Inspect soils below footings for adequate bearing capacity and consistency with geotechnical report. ~Inspect removal of unsuitable material and preparation of subgrade prior to placement of controlled fill	C
2. Controlled Structural Fill	PE/GE	~Perform sieve tests (ASTM D422 & D1140) and modified Proctor tests (ASTM D1557) of each source of fill material. ~Inspect placement, lift thickness and compaction of controlled fill. ~Test density of each lift of fill by nuclear methods (ASTM D2922) ~Verify extent and slope of fill placement.	P
4. Pier Foundations			
5. Pile Foundations			
6. Other Reports			

**NOTES:**

Inspection frequency:

P: Periodic inspections. Inspection frequency shall be determined by the Geotechnical Engineer.

During ongoing soil & foundation operations, daily (minimum) inspections shall be performed.

C: Continuous

<b>Item</b>	<b>Agency # (Qualif.)</b>	<b>Scope</b>	<b>Inspection Frequency</b>
1. Mix Design	ACI-CCI ICC-RCSI	Review concrete batch tickets and verify compliance with approved mix design. Verify that water added at the site does not exceed that allowed by the mix design.	C
2. Material Certification	ACI-CCI	Review mill certificates for conformance with specifications and requirements.	C
3. Reinforcement Installation	ACI-CCI ICC-RCSI	~Inspect size, spacing, cover, positioning and grade of reinforcing steel. ~Verify that reinforcing bars are free of form oil or other deleterious materials. Inspect bar laps and mechanical splices. Verify that bars are adequately tied and supported on chairs or bolsters	P1
4. Post-Tensioning Operations			
5. Welding of Reinforcing			
6. Anchor Rods	ACI-CCI	~Inspect size, positioning and embedment of anchor rods. ~Inspect concrete placement and consolidation around anchors.	C
7. Concrete Placement	ACI-CCI ICC-RCSI	~Inspect placement of concrete. ~Verify that concrete conveyance and depositing avoids segregation or contamination. ~Verify that concrete is properly consolidated.	C
8. Sampling and Testing of Concrete	ACI-CFTT ACI-STT	Test concrete compressive strength (ASTM C31 & C39), slump (ASTM C143), air-content (ASTM C231 or C173) and temperature (ASTM C1064).	P2
9. Curing and Protection	ACI-CCI ICC-RCSI	Inspect curing, cold weather protection and hot weather protection procedures.	P3
10. Other:			

**NOTES:**

Inspection frequency:

P: Periodic inspections

C: Continuous Inspection

All periodic inspections shall be performed in accordance with "Cast-In-Place Concrete" Specification per IBC referenced standards and the project specifications. . Additional requirements are as follows:

P1 - Inspect before concrete placement.

P2 - Per "Cast-In-Place Concrete" Specification

P3 - Daily when required by weather conditions. (see also ACI 305R, ACI 306R, ACI 306.1)

Item	Agency # (Qualif.)	Scope	Inspection Frequency
1. Fabricator Certification/ Quality Control Procedures <input type="checkbox"/> Fabricator Exempt	EIT	<i>Inspect shop fabrication and quality control procedures for wood truss plant.</i>	P
2. Material Grading	EIT	<i>Verify panel and framing member grade and thickness.</i>	P
3. Connections	EIT	~Verify fastener type and installation procedures. Verify that fasteners conform to IBC reference standard requirements and the contract documents. ~Verify that fasteners are installed tightly.	P
4. Framing and Details	EIT	Verify that grade, thickness, type, size, quantity, location, details, and connections of framing members conform to IBC reference standard requirements and the contract documents.	P
5. Diaphragms and Shearwalls	EIT	~Inspect size, configuration, blocking and fastening of shearwalls and diaphragms. ~Verify panel grade and thickness.	C
6. Wood Diaphragms	EIT	~Verify nominal framing members at adjoining panel edges ~Verify nail or staple diameter and length as specified on the construction documents. ~Verify number of fastener lines and that the spacing between fasteners in each line and at edge margins agree with contract documents and specifications.	C
7. Prefabricated Wood Trusses	EIT	<i>Inspect the fabrication of wood trusses.</i>	P
9. Other:			

Note:

Special inspections of fabricator are not required if fabricator is approved per IBC section 1704.2.5.

Inspection frequency:

C: Continuous Inspection

P: Periodic Inspections:

All periodic inspections shall be performed in accordance with the "Rough Carpentry" Specification and any wood construction related specification per IBC referenced standards and the project specifications.