Innovative Design
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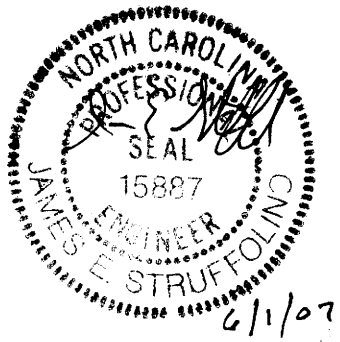
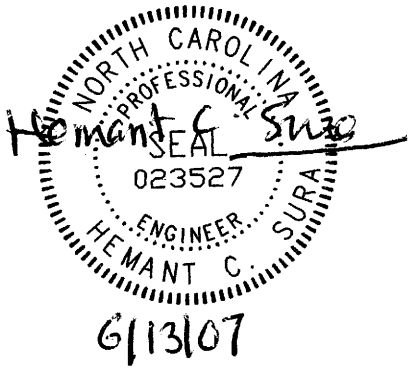
Wilkes County Visitor's Center

Wilkesboro, NC

North Carolina Department of Transportation
Roadside Environmental Unit

100% Construction Document
Specifications
June 1, 2007

SEALS PAGE

 6/12/07 **Architect**	 6/1/07 **Structural**
 6/13/07 **Electrical**	 **Plumbing/Mechanical**

SECTION 00010
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Documents 0 – Introductory Information, Bidding Requirements, and Contract Requirements

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SECTION 01010

CODES AND STANDARDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 CODES

A. Project design and construction shall meet all governing codes, standards and regulations. Among the codes and standards to be complied with are the following:
   1. North Carolina State Building Code including the General, Mechanical, Electrical, Accessibility,Energy, Fire, and Gas Volumes
   2. ADA Requirements
   3. NEMA Standards
   4. ASHRAE Guide (latest edition) including ASHRAE 90 and ASHRAE Standard for Energy Conservation in New Buildings
   5. UL Standards
   6. NFPA Guide including the following:
      a. NFPA 72A: Local Protection Signaling Systems
      b. NFPA 90A: Ducts, Fire Dampers, Air Conditioning and Ventilation Systems
      c. NFPA 91: Blower and Exhaust Systems
      d. NFPA 101: Life Safety Code
   7. Code for Energy Conservation in New Building Construction (Jointly prepared by BOCA, ICBO and SBCCI Codes

PART 2 PRODUCTS

2.01 Not Used.

PART 3 EXECUTION

3.01 Not Used.

END OF SECTION

SECTION 01100

SUMMARY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 PROJECT

A. Project Name: Wilkes County Visitor's Center.

B. Owner's Name: North Carolina Department of Transportation.

C. Architect's Name: Innovative Design, Inc., 850 West Morgan Street, Raleigh, NC 27603.

D. The Project consists of the construction of a new Visitor's Center and Highway Rest Area along Route 421 Westbound near North Wilkesboro, NC. The project shall be certified as "Platinum" level of US Green Building Council's LEED certification program.

1.03 CONTRACT DESCRIPTION

A. Contract Type: A single prime contract based on a Stipulated Price as a part of the entire rest area project.

1.04 OWNER OCCUPANCY

A. Owner intends to occupy the Project by the date stated in the Agreement as the contract completion date.

B. The contractor shall cooperate with Owner to minimize conflict and to facilitate Owner's operations.

C. The contractor shall schedule the Work to accommodate Owner occupancy.

1.05 CONTRACTOR USE OF SITE AND PREMISES

A. The contractor shall arrange use of site and premises to allow:
   1. Owner occupancy at Substantial Completion.
   2. Work by Others.
   3. Work by Owner.

B. Provide access to and from site as required by law and by Owner:

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01300

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Preconstruction meeting.

B. Progress meetings.

C. Construction progress schedule.

D. Progress photographs.

E. Submittals for review, information, and project closeout.

F. Number of copies of submittals.

G. Submittal procedures.

1.03 RELATED SECTIONS

A. Section 01100 - Summary: Description of the Work. Work covered by each contract, occupancy, and contractor use of site.

B. Section 01732 - Construction Waste Management: Implementation of the Waste Management Plan.

C. Section 01700 - Execution Requirements: Additional coordination requirements.

D. Section 01780 - Closeout Submittals: Project record documents.

E. Section 01810 - Commissioning: Additional procedures for submittals relating to commissioning.
   1. Where submittals are indicated for review by both Architect and the Commissioning Authority, submit one extra and route to Architect first, for forwarding to the Commissioning Authority.
   2. Where submittals are not indicated to be reviewed by Architect, submit directly to the Commissioning Authority; otherwise, the procedures specified in this section apply to commissioning submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRECONSTRUCTION CONFERENCE

A. Owner will schedule a meeting after Notice of Award.

B. Attendance Required:
   1. Owner.
   2. Architect.
   3. Prime Contractor(s).

C. Agenda:
   1. Execution of Owner-Contractor Agreement.
   2. Submission of executed bonds and insurance certificates.
   3. Distribution of Contract Documents.

4. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
5. Designation of personnel representing the parties to Contract, Owner's Project Manager and Architect.
6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
7. Scheduling.

D. Architect shall record minutes and distribute copies within two days after meeting to participants, with copies to Contractor, Owner, participants, and those affected by decisions made.

3.02 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at maximum monthly intervals.

B. Architect will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required: Project Manager and Job superintendent for each Prime Contractor, major Subcontractors and suppliers, Owner, Architect and Design Consultants, as appropriate to agenda topics for each meeting.

D. Agenda:
1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems which impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Maintenance of progress schedule.
7. Corrective measures to regain projected schedules.
8. Planned progress during succeeding work period.
9. Coordination of projected progress.
10. Review of implementation and progress of Waste Management Plan.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

E. Architect will record minutes and distribute copies within two days after meeting to participants, with copies to Contractor, Owner, participants, and those affected by decisions made.

3.03 CONSTRUCTION PROGRESS SCHEDULE

A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

3.04 PROGRESS PHOTOGRAPHS

A. Photography Type: Digital; electronic files.

B. Provide photographs of site and construction throughout progress of Work produced by an experienced photographer, acceptable to Architect.

C. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
   1. Delivery Medium: Via email.
   2. File Naming: Include project identification, date and time of view, and view identification.

3.05 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.
   4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.

C. Samples will be reviewed only for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01780 - CLOSEOUT SUBMITTALS.

3.06 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. Certificates.
   3. Test reports.
   4. Inspection reports.
   5. Manufacturer's instructions.
   6. Manufacturer's field reports.
   7. LEED Report.
   8. Other types indicated.

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

3.07 SUBMITTALS FOR PROJECT CLOSEOUT

A. When the following are specified in individual sections, submit them at project closeout:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   4. Bonds.
   5. Other types as indicated.

B. Submit for Owner's benefit during and after project completion.

3.08 NUMBER OF COPIES OF SUBMITTALS

A. Documents for Review : As specified in General Conditions.
   1. Submit the number of copies which the Contractor requires, plus two copies which will be retained by the Architect and one copy which will be retained by Owner. Under no circumstances should fewer than six (6) copies be submitted for review.
   2. Larger Sheets, Not Larger Than 36 x 48 inches: Submit one reproducible transparency and one opaque reproduction.

B. Documents for Information: Submit number required by Owner plus two copies to the Architect.

C. Documents for Project Closeout: As specified in the General Conditions and Section 01780-Closeout Submittals

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

3.09 SUBMITTAL PROCEDURES

A. Transmit each submittal with Contractor's form approved by the Architect and Owner.

B. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

C. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.

D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.

E. Deliver submittals to Architect at business address.

F. Schedule submittals to expedite the Project, and coordinate submission of related items.

G. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.

H. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.

I. Provide space for Contractor and Architect review stamps.

J. When revised for resubmission, identify all changes made since previous submission.

K. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

L. Submittals not requested will not be recognized or processed.

END OF SECTION

SECTION 01355

LEED CERTIFICATION PROCEDURES

PART 1 GENERAL

1.01 PROJECT GOALS

A. This project has been designed to achieve the LEED-NC Platinum (minimum 52 points) rating, as defined in the LEED(tm) Green Building Rating System for New Construction and Major Renovations, Version 2.1, November 2002.

B. Contractor shall familiarize himself with the relevant requirements and provide the necessary information and instruction to all subcontractors and installers.

C. Since Contractor and subcontractors may not be familiar with LEED requirements, this section includes a summary of the products and procedures intended to achieve LEED credits.
   1. Some credits are marked PREREQUISITE; these must be achieved regardless of the level of certification; many are dependent on proper performance by Contractor and subcontractors.
   2. Other credits involve quantifying percentages by weight and cost; these require careful recordkeeping and reporting by the Contractor.
   3. See www.usgbc.org for more information.

1.02 RELEVANT SECTIONS

A. Sections that include requirements intended to achieve LEED credits include, but are not limited to, the following:

B. Section 01734 - Indoor Air Quality:
   1. Contractor's IAQ management plan and construction procedures; EQ Credit 3.1.
   2. Building flush out or air contaminant testing; EQ Credit 3.2.

C. Section 01600 - Product Requirements: Overall project requirements for:
   1. Reused products; MR Credits 3.1 and 3.2.
   2. Recycled content; MR Credits 4.1 and 4.2.
   3. Regionally-sourced products; MR Credits 5.1 and 5.2.
   4. Rapidly renewable material content; MR Credit 6.
   5. Certified (sustainably harvested) wood; MR Credit 7.
   6. Project-wide VOC requirements for adhesives; IEQ Credit 4.1.
   7. Project-wide VOC requirements for joint sealants, including duct sealers; IEQ Credit 4.1.
   8. Project-wide VOC requirements for paints; IEQ Credit 4.2.
   9. Project-wide prohibition of added-urea-formaldehyde-containing particleboard, plywood, medium density fiberboard (MDF), wheatboard, strawboard, panel substrates, door cores, and laminating adhesives used on-site or in the shop; EQ Credit 4.4.

D. Section 01732 - Waste Management: Construction waste management; MR Credits 2.1 and 2.2.

E. Section 01780 - Closeout Submittals: Maintenance and operation manuals for commissioned systems; EA Credit 3.

F. Section 01820 - Demonstration and Training:
   1. Fundamental commissioning; EA PREREQUISITE 1.

G. Section 01810 - Commissioning:
   1. Fundamental commissioning; EA PREREQUISITE 1.

H. Section 01815 - Commissioning Authority Responsibilities:
   1. Fundamental commissioning; EA PREREQUISITE 1.

I. Section 02630 - Rainwater Collection System:
   1. WE Credit 2, 3.1, and 3.2.

J. Section 03300 - Cast-In-Place Concrete:
   1. Requirement to use recovered materials such as fly ash; MR Credit 4.1 and 4.2.

K. Section 03355 - Concrete Floor Finishing:
   1. Requirement to use bio-based concrete stain and sealer as rapidly renewable materials; MR Credit 6.

L. Section 04810 - Unit Masonry Assemblies:
   1. Requirement to use recycled or recovered materials; MR Credit 4.1 and 4.2.

M. Section 05120 - Structural Steel:
   1. Requirement to use steel with recycled content; MR Credit 4.1 and 4.2.

N. Section 05500 - Metal Fabrication:
   1. Requirement to use metal with recycled content; MR Credit 4.1 and 4.2.

O. Section 06100 - Rough Carpentry:
   1. Requirement to use sustainably harvested wood; MR Credit 7.
   2. Requirement for prohibition of added urea-formaldehyde for composite wood materials; IEQ Credit 4.4.

P. Section 06176 - Engineered Wood Joists and Beams:
   1. Requirement to use sustainably harvested wood; MR Credit 7.

Q. Section 06181 - Glued-Laminated Structural Units
   1. Requirement to use sustainably harvested wood; MR Credit 7.

R. Section 06200 - Finish Carpentry:
   1. Requirement to use sustainably harvested wood; MR Credit 7.

S. Section 06410 - Custom Cabinets:
   1. Requirement to use sustainably harvested wood; MR Credit 7.
   2. Requirement to use rapidly renewable materials such as agri-fiber board or bamboo; MR Credit 6.

T. Section 06415 - Countertop:
   1. Requirement to use solid countertop with recycled content; MR Credit 4.1 & 4.2.

U. Section 07140 - Fluid-Applied Waterproofing:
   1. Requirement to use bio-based liquid waterproofing as rapidly renewable material; MR Credit 6.

V. Section 07212 - Board and Batt Insulation:
   1. Requirement for recycled content; MR Credit 4.1 and 4.2.

W. Section 07214 - Foam-In-Place Insulation:
   1. Requirement to use soy-based foam-in-place insulation as rapidly renwable material; MR Credit 6.

X. Section 07530 - Elastomeric Membrane Roofing with Applied Standing Seam Profile:
   1. EnergyStar white membrane roofing; SS Credit 7.2.

Y. Section 07840 - Firestopping: LEED-VOC-compliant firestopping sealants; EQ Credit 4.1.

Z. Section 07900 - Joint Sealers: LEED-VOC-compliant sealants; EQ Credit 4.1.

AA. Section 08211 - Flush Wood Doors:
   1. Requirement to use sustainably harvested wood; MR Credit 7.

AB. Section 09260 - Gypsum Board Assemblies:
1. Requirement to use synthetic gypsum board for recovered and recycled content; MR Credit 4.1 and 4.2.

AC. Section 09300 - Tile:
1. Requirement to use tile with recycled content; MR Credit 4.1 and 4.2.

AD. Section 09511 - Suspended Acoustical Ceiling:
1. Requirement for recycled content in ceiling tile and metal track; MR Credit 4.1 and 4.2.

AE. Section 09650 - Resilient Flooring:
1. Requirement to use linoleum tiles as rapidly renewable material; MR Credit 6.

AF. Section 09685 - Carpet Tile:
1. Carpet tile complying with CRI Green Label Plus requirements; IEQ Credit 4.3.
2. Requirement for recycled content in carpet tile; MR Credit 4.1 and 4.2.

AG. Section 09900 - Paints and Coatings: LEED-VOC-compliant interior opaque paints and coatings; EQ Credit 4.2.

AH. Section 12486 - Floor Mats:
1. Floor mats and recessed frames at high volume entryways; EQ Credit 5.
2. Requirement to use floor mats with recycled content; MR Credit 4.1 and 4.2.

AI. Section 15410 - Plumbing Fixtures:
1. High efficiency and dry toilet fixtures; occupant sensors; WE Credit 2.
2. High efficiency and dry toilet fixtures; occupant sensors; WE Credit 3.

1.03 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. LEED Report: For each product with the notation "show quantity on LEED report," submit a report with the following information:
1. Submit with each Application for Payment; update the Report each period with latest period shown separately:
2. Identify each product with:
   a. Name and manufacturer.
   b. Specification section number.
   c. Applicable Credit(s).
   d. Net weight per unit.
   e. Quantity installed.
   f. Material cost per unit.
   g. Total material cost.
   h. Location of harvest or manufacturer.
3. Attach evidence of compliance from either the manufacturer or an independent agency.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. General product requirements.

B. LEED-related product requirements.

C. Transportation, handling, storage and protection.

D. Product option requirements.

E. Substitution limitations and procedures.

F. Spare parts and maintenance materials.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Requirements for LEED reports.

B. Section 01601 - Substitution Request Form: Form to be submitted with any Contractor proposed substitution.

1.04 REFERENCES

A. GreenSeal GS-36 - Commercial Adhesives; Green Seal, Inc.; 2000.

B. NFPA 70 - National Electrical Code; National Fire Protection Association; 2005.

C. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; www.aqmd.gov.

1.05 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
   1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

D. LEED Submittals: Refer to Section 01355.

E. Indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

F. Provide lead time for each product to be delivered to the site.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by the Contract Documents.

B. Do not use products having any of the following characteristics:
   1. Made using or containing CFC's or HCFC's.
   2. Made of wood from newly cut old growth timber.

C. Where all other criteria are met, Contractor shall give preference to products that:
   1. Are extracted, harvested, and/or manufactured closer to the location of the project.
   2. Have longer documented life span under normal use.
   3. Result in less construction waste.
   4. Are made of vegetable materials that are rapidly renewable.

D. Regionally-Sourced Products:
   1. Overall Project Requirement: Provide materials amounting to a minimum of 20 percent of the total value of all materials (excluding plumbing, HVAC, electrical, elevators, and other equipment) that have been extracted, harvested, or recovered, as well as manufactured, within a radius of 500 miles from the project site.
      a. Locally-Manufactured Products: Provide a minimum of 20 percent of all products manufactured (final assembly) within a radius of 500 miles from the project site.
         1) This provision is applicable to LEED Credit MR 5.1; show quantity on LEED report.
      b. Primary Materials: Provide a minimum of 50 percent of the locally manufactured products also extracted, harvested, or recovered within a radius of 500 miles from the project site.
         1) This provision is applicable to LEED Credit MR 5.2; show quantity on LEED report
   2. Specific Product Categories: Provide regionally-sourced products as specified elsewhere.
   3. LEED Submittals: Indicate location of manufacture; in all cases indicate location of final assembly; for harvested products, indicate location of harvest; for extracted (i.e. mined) products, indicate location of extraction; for products involving multiple manufacturing steps, indicate all locations of manufacture or assembly; provide manufacturer or supplier certification of location information.

E. Products with Rapidly Renewable Material Content:
   1. Definition: Materials made from plants that are typically harvested within 10 years or less after planting.
   2. Overall Project Requirement: Provide a minimum of 5 percent of all products made of materials that are rapidly renewable, such as fast-growing trees and other vegetation, wool, cotton, etc.
      a. This provision is applicable to LEED Credit MR 6; show quantity on LEED report.
   3. Specific Product Categories: Provide renewable material content as specified elsewhere.
   4. Calculations: Where information about renewable material content is required to be submitted and an item is not made completely of rapidly renewable material, calculate content by dividing the renewable material content by weight by the total weight of the item.
   5. LEED Submittals: State unit cost, renewable material content percentage, quantity installed, total material cost, and total renewable material value; attach evidence of contents from either manufacturer or an independent agency.

F. Products with Recycled Content:
   1. Overall Project Requirement: Provide products with recycled content such that the sum of post-consumer recycled content plus one-half of the post-industrial recycled content constitutes at least 10 percent (2 points) of the total value of all products installed, except mechanical and electrical components.
      a. This provision is applicable to LEED Credit MR 4; show quantity and calculations on LEED report.

2. Specific Product Categories: Provide recycled content as specified elsewhere.
3. Calculations: Where information about recycled content is required to be submitted:
   a. Determine percentage of post-consumer and post-industrial content separately, using the guidelines contained in 16 CFR 260.7(e).
   b. Previously used, reused, refurbished, and salvaged products are not considered recycled.
   c. Wood fabricated from timber abandoned in transit to original mill is considered reused, not recycled.
   d. Determine percentage of recycled content of any item by dividing the weight of recycled content in the item by the total weight of all material in the item.
   e. Determine value of recycled content of each item separately, by multiplying the content percentage by the value of the item.
4. LEED Submittals: State unit cost, post-consumer and post-industrial content percentages, quantity installed, total material cost, and total recycled content value; attach evidence of contents from either manufacturer or an independent agency.

G. Sustainably Harvested Wood:
1. Definition: Wood-based materials include but are not limited to structural framing, dimension lumber, flooring, wood doors, finishes, and furnishings that are permanently installed in the project. Wood and wood-based products not permanently installed in the project are not included in the definition.
2. Overall Project Requirement: Provide a minimum of 50 percent of all wood-based materials made of sustainably harvested wood.
   a. This provision is applicable to LEED Credit MR 7; show quantity on LEED report and submit certificates.
3. Specific Wood-Based Fabrications: Fabricate of sustainably harvested wood when so specified elsewhere.
4. Certification: Provide wood certified or labeled by an organization accredited by one of the following:
   a. The Forest Stewardship Council, The Principles for Natural Forest Management; for Canada visit http://www.fsccanada.org, for the USA visit http://www.fscus.org.
5. LEED Submittals: State unit cost of each wood-based item, quantity installed, quantity certified as sustainably harvested, total wood-based material cost, and total sustainably harvested value; provide letter of certification signed by supplier of each item, indicating compliance with the specified requirements and identifying the certifying organization.
   a. Include the certifying organization's certification numbers for each certified product, itemized on a line-item basis.
   b. Attach copies of invoices bearing the certifying organization's certification numbers.

H. Urea-Formaldehyde Prohibition:
1. Overall Project Requirement: Provide composite wood and agrifiber products having no added urea-formaldehyde resins.
   a. This provision is applicable to LEED Credit EQ 4.4; submit LEED Prohibited Content Installer Certification Forms.
   b. Require each installer to certify compliance and submit product data showing product content.
2. Specific Product Categories: Comply with limitations specified elsewhere.

I. Adhesives and Joint Sealants:
1. Definition: This provision applies to gunnable, trowelable, and liquid-applied adhesives, sealants, and sealant primers used anywhere on the interior of the building inside the weather barrier, including duct sealers.
2. Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.
   a. This provision is applicable to LEED Credit EQ 4.1.

b. Require each installer to certify compliance and submit product data showing product content.

3. Specific Product Categories: Comply with limitations specified elsewhere.

J. Paints:
1. For interior paints, provide only products having lower volatile organic compound (VOC) content than required by Green Seal's Standard GS-11.
a. This provision is applicable to LEED Credit EQ 4.2.
b. Require each installer to certify compliance and submit product data showing product content.

K. Carpet:
1. Provide only product meeting or exceeding the requirements of the Carpet and Rug Institute's Green Label indoor Air Test Program.
a. This provision is applicable to LEED Credit EQ 4.3
b. Require each installer to certify compliance and submit product data showing product content.

L. Provide interchangeable components of the same manufacture for components being replaced.

M. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Size terminal lugs to NFPA 70, include lugs for terminal box.

N. Cord and Plug: Provide minimum 6 foot cord and plug including grounding connector for connection to electric wiring system. Cord of longer length is specified in individual specification sections.

2.02 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Provide spare parts, maintenance, and extra products of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION PROCEDURES

A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.

B. For Substitutions after the bid period, follow the procedures for Substitutions outlined in the General Conditions and as described in this Section.

C. Architect will consider requests for substitutions only within 30 days after date of Agreement.

D. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

E. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

F. A request for substitution constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Will provide the same warranty for the substitution as for the specified product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.
   5. Will reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.

G. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

H. Substitution Submittal Procedure:
   1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
   2. Provide Substitution Request Form (Section 01601) with each proposed substitution.
   3. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
   4. The Architect will notify Contractor in writing of decision to accept or reject request.

3.02 TRANSPORTATION AND HANDLING

A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

B. Transport and handle products in accordance with manufacturer's instructions.

C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

F. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

G. Promptly return damaged shipments or incorrect orders to manufacturer for credit or refund.

H. Transport materials in covered trucks to prevent contamination of product or littering of surrounding areas.

3.03 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

G. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

H. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

I. Prevent contact with material that may cause corrosion, discoloration, or staining.

J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 01601

SUBSTITUTION REQUEST FORM

TO:

Architect:

Innovative Design, Inc.

850 West Morgan Street

Raleigh, NC 27603

Project Name:

Wilkes County Visitor's Center

North Wilkesboro, NC

SUPPLIER/SUBCONTRACTOR: _____

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

Section	Paragraph	Specified Item
_____	_____	_____

Proposed substitution: _____

Attach complete dimensional and technical data, including laboratory tests, if applicable.

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

Submit with request, all necessary samples and substantiating data to prove equal quality and performance to that which is specified. Clearly mark manufacturer's literature to indicate equality in perofrmance. Differences in quality of materials and construction shall be indicated.

Fill in blanks below:

1. Does the substitution affect dimensions shown on Drawings?
   Yes ____ No____ If yes, clearly indicate changes._____
   _____
2. Will the undersigned pay for changes to the building design, including engineering and detailing costs caused by the requested substitution?
   Yes ____ No____
3. What effect does the substitution have on other trades?_____
   _____
4. What effect does the substitution have on applicable code requirements?_____
   _____
5. What are the differences between the proposed substitution and the specified product?
   _____
   _____
   _____
6. Manufacturer's guarantees of the proposed and specified items are:
   _____ Same _____ Different - Explain: _____
   _____
   _____

CERTIFICATION OF EQUAL PERFORMANCE

AND ASSUMPTION OF LIABILITY FOR

EQUAL PERFORMANCE

Submitted by:

_____

Signature Title

_____

Firm

_____

Address

_____

Telephone Date

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

END OF SECTION

SECTION 01700

EXECUTION REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Pre-installation meetings.

C. Cutting and patching.

D. Surveying for laying out the work.

E. Cleaning and protection.

F. Starting of systemsand equipment.

G. Demonstration and instruction of Owner personnel.

H. Closeout procedures, except payment procedures.

1.03 SUBMITTALS

A. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.
   2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in conformance with Contract Documents.
   3. Submit surveys and survey logs for the project record.

B. Cutting and Patching: Submit written request in advance of cutting or alteration which affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate Contractor.
   6. Include in request:
      a. Identification of Project.
      b. Location and description of affected work.
      c. Necessity for cutting or alteration.
      d. Description of proposed work and products to be used.
      e. Effect on work of Owner or separate Contractor.
      f. Written permission of affected separate Contractor.
      g. Date and time work will be executed.

C. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.04 PROJECT CONDITIONS

A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

B. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

C. Pest Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.

D. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

E. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

1.05 COORDINATION

A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Notify affected utility companies and comply with their requirements.

C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

D. Coordinate space requirements, supports, and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

F. Coordinate completion and clean-up of work of separate sections.

G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01600.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify Architect four days in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review conditions of examination, preparation and installation procedures.
   2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Contractor shall locate and protect survey control and reference points.

D. Control datum for survey is that established by Owner provided survey.

E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

F. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

H. Utilize recognized engineering survey practices.

I. Establish a minimum of three permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.

J. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.

K. Periodically verify layouts by same means.

L. Maintain a complete and accurate log of control and survey work as it progresses.

M. On completion of foundation walls and major site improvements, prepare a certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.

3.05 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 CUTTING AND PATCHING

A. Execute cutting and patching including excavation and fill to complete the work, to uncover work in order to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit products together to integrate with other work.

B. Execute work by methods to avoid damage to other work, and which will provide appropriate surfaces to receive patching and finishing.

C. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

D. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

E. Restore work with new products in accordance with requirements of Contract Documents.

F. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

G. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07840, to full thickness of the penetrated element.

H. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

I. Make neat transitions. Patch work to match adjacent work in texture and appearance.

J. Patch or replace surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. Repair substrate prior to patching finish. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.07 PROGRESS CLEANING

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

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and rubbish from site periodically and dispose of as specified in Section 01732.

E. Control accumulation of waste materials and trash. Recycle or dispose of off-site in compliance with waste management procedures specified in Section 01732.

3.08 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Prohibit traffic from landscaped areas.

H. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

3.09 STARTING SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect and owner seven days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable Contractor personnel in accordance with manufacturers' instructions.

G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.10 ADJUSTING

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

B. Testing, adjusting, and balancing HVAC systems: See Section 15950 and 01400.

3.11 FINAL CLEANING

A. Execute final cleaning prior to Substantial Completion.
   1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.

B. Use cleaning materials that are nonhazardous.

C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

E. Replace filters of operating equipment.

F. Clean debris from roofs, gutters, downspouts, and drainage systems.

G. Clean site; sweep paved areas, rake clean landscaped surfaces.

H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.12 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect and Owner.

B. Notify Architect when work is considered ready for Substantial Completion.

C. Submit written certification that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's review.

D. Owner will occupy all of the building as specified in Section 01100.

E. Correct items of work listed in executed Certificates of Substantial Completion and comply with requirements for access to Owner-occupied areas.

F. Notify Architect when work is considered finally complete.

G. Complete items of work determined by Architect's final inspection.

END OF SECTION

SECTION 01732

WASTE MANAGEMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Owner may decide to pay for additional recycling, salvage, and/or reuse based on Landfill Alternatives Proposal specified below.

E. Required Recycling, Salvage, and Reuse: The materials including, but not limited to, following may not be disposed of in landfills or by incineration:
   1. Aluminum and plastic beverage containers.
   2. Corrugated cardboard.
   3. Wood pallets.
   4. Clean dimensional wood: May be used as blocking or furring, subject to conformance with performance specifications .
   5. Land clearing debris, including brush, branches, logs, and stumps.
   6. Concrete: May be crushed and used as riprap, aggregate, sub-base material, or fill.
   7. Concrete masonry units: May be used on project if whole, or crushed and used as sub-base material or fill.
   8. Asphalt paving: May be recycled into paving for project.
   9. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
   10. Glass.
   11. Gypsum drywall and plaster.
   12. Plastic buckets.
   13. Carpet, carpet cushion, carpet tile, and carpet remnants: DuPont (http://flooring.dupont.com) and Interface (www.interfaceinc.com) conduct reclamation programs.
   14. Paint.
   15. Plastic sheeting.
   16. Rigid foam insulation.
   17. Windows, doors, and door hardware.
   18. Plumbing fixtures.
   19. Mechanical and electrical equipment.
   20. Fluorescent lamps (light bulbs).
   21. Acoustical ceiling tile and panels.

F. LEED Certification for this project is dependent on diversion of minimum 50 percent, by weight, of potential landfill trash/waste by recycling and/or salvage.

G. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, recycling, salvage,

and reuse must be reported regardless of to whom the cost or savings accrues.

H. Contractor shall develop and follow a Waste Management Plan designed to implement these requirements.

I. The following sources may be useful in developing the Waste Management Plan:
   1. Recycling Haulers and Markets contact Mary Beth Powell, Manager, Solid Waste Reduction Program, Office of Waste Reduction, Environment, Health and Natural Resources, 3825 Barrett Drive, Raleigh, NC 27609; Phone: (919) 571-4100; Fax: (919) 571-4135

J. Methods of trash/waste disposal that are not acceptable are:
   1. Burning on the project site.
   2. Burying on the project site.
   3. Dumping or burying on other property, public or private.
   4. Other illegal dumping or burying.
   5. Incineration, either on- or off-site.

K. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, State and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.03 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

B. Construction Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. Return: To give back reusable items or unused products to vendors for credit.

J. Reuse: To reuse a construction waste material in some manner on the project site.

K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Landfill Alternatives Proposal: Within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner, submit a projection of trash/waste that will require disposal and alternatives to landfilling, with net costs.
   1. Submit to Architect for Owner's review and approval.
   2. If Owner wishes to implement any cost alternatives, the Contract Sum will be adjusted as specified elsewhere.
   3. Include an analysis of trash/waste to be generated and landfill options as specified for Waste Management Plan described below.
   4. Describe as many alternatives to landfilling as possible:
      a. List each material proposed to be salvaged, reused, or recycled.
      b. List the proposed local market for each material.
      c. State the estimated net cost resulting from each alternative, after subtracting revenue from sale of recycled or salvaged materials and landfill tipping fees saved due to diversion of materials from the landfill.

C. Once Owner has determined which of the landfill alternatives addressed in the Proposal above are acceptable, prepare and submit Waste Management Plan; submit within 10 calendar days after notification by Architect.

D. Waste Management Plan: Include the following information:
   1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
   2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
   3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
      a. List each material proposed to be salvaged, reused, or recycled.
      b. List the local market for each material.
      c. State the estimated net cost, versus landfill disposal.
   4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
   5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
   6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.
   7. Recycling Incentives: Describe procedures required to obtain credits, rebates, or similar incentives.

E. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
   1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
   2. Submit Report on a form acceptable to Owner.
   3. Landfill Disposal: Include the following information:
      a. Identification of material.

b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.

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

F. Recycling Incentive Programs:
1. The General Contractor shall be responsible for final implementation of programs involving tax credits or rebates or similar incentives related to recycling, if applicable to the Project. Revenues or other savings obtained for recycling or returns shall accrue to the General Contractor.
   a. The General Contractor is responsible for obtaining information packets relevant to tax credit or rebate programs prior to starting work on the Project.
   b. The General Contractor shall document work methods and recycled materials that qualify for tax credits, rebates, and other savings under any related program. Submit copies of documentation required to qualify for incentives.
2. Where revenue accrues to Contractor, submit copies of documentation required to qualify for incentive.
3. Where revenue accrues to Owner, submit any additional documentation required by Owner in addition to information provided in periodic Waste Disposal Report.

PART 2 PRODUCTS

2.01 PRODUCT SUBSTITUTIONS

A. See Section 01600 - Product Requirements for substitution submission procedures.

B. For each proposed product substitution, submit the following information in addition to requirements specified in Section 01600:
1. Relative amount of waste produced, compared to specified product.
2. Cost savings on waste disposal, compared to specified product, to be deducted from the Contract Sum.
3. Proposed disposal method for waste product.
4. Markets for recycled waste product.

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

A. See Section 01300 for additional requirements for project meetings, reports, submittal

procedures, and project documentation.

B. See Section 01600 for waste prevention requirements related to delivery, storage, and handling.

C. See Section 01700 for trash/waste prevention procedures related to cutting and patching, installation, protection, and cleaning.

3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.

B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.

C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

D. Meetings: Discuss trash/waste management goals and issues at project meetings.
   1. Pre-bid meeting.
   2. Pre-construction meeting.
   3. Regular job-site meetings.
   4. Job safety meetings.

E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
   1. As a minimum, provide:
      a. Separate area for storage of materials to be reused on-site, such as wood cut-offs for blocking.
      b. Separate dumpsters for each category of recyclable.
      c. Recycling bins at worker lunch area.
   2. Provide containers as required.
   3. Provide temporary enclosures around piles of separated materials to be recycled or salvaged.
   4. Provide materials for barriers and enclosures that are nonhazardous, recyclable, or reusable to the maximum extent possible; reuse project construction waste materials if possible.
   5. Locate enclosures out of the way of construction traffic.
   6. Provide adequate space for pick-up and delivery and convenience to subcontractors.
   7. If an enclosed area is not provided, clearly lay out and label a specific area on-site.
   8. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

SECTION 01734

INDOOR AIR QUALITY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Construction procedures to promote adequate indoor air quality after construction.

B. Building flush-out after construction and before occupancy OR testing indoor air quality after completion of construction.

C. Testing air change effectiveness after completion of construction.

1.02 PROJECT GOALS

A. Dust and Airborne Particulates: Prevent deposition of dust and other particulates in HVAC ducts and equipment.
   1. Cleaning of ductwork is not contemplated under this Contract.
   2. Contractor shall bear the cost of cleaning ductwork and equipment required due to failure to protect ducts and equipment from construction dust, rain, moisture, or volatile or hazardous materials.

B. Airborne Contaminants: Procedures and products have been specified to minimize indoor air pollutants.
   1. Furnish products meeting the specifications.
   2. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.

C. Ventilation: HVAC system has been designed to achieve the minimum requirements for ventilation specified in ASHRAE 62.1.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: LEED credits relating to indoor air quality.

B. Section 15990 - Testing, Adjusting, and Balancing: Testing HVAC systems for proper air flow rates, adjustment of dampers and registers, and settings for equipment.

1.04 REFERENCES

A. ASHRAE Std 62.1 - Ventilation For Acceptable Indoor Air Quality; 2004.

B. ASHRAE Std 129 - Measuring Air-Change Effectiveness; 1997 (Reaffirmed 2002).

C. SMACNA (OCC) - IAQ Guideline for Occupied Buildings Under Construction; 1995.

1.05 DEFINITIONS

A. Adsorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.

B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.

C. Particulates: Dust, dirt, and other airborne solid matter.

D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

1.06 SUBMITTALS

A. Indoor Air Quality Management Plan: Describe in detail measures to be taken to promote

adequate indoor air quality upon completion; use SMACNA IAQ Guidelines for Occupied Buildings Under Construction 1995, Chapter 3, as a guide.

1. Submit not less than 60 days before enclosure of building.
2. Identify potential sources of odor and dust.
3. Identify construction activities likely to produce odor or dust.
4. Identify areas of project potentially affected.
5. Evaluate potential problems by severity and describe methods of control.
6. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters and schedule for replacement of filters.
7. Describe cleaning and dust control procedures.
8. Describe coordination with commissioning procedures.
9. Describe all actions to be taken following requirements under PART 3 EXECUTION in this Section.

B. Duct and Terminal Unit Inspection Report.

C. Air Contaminant Test Plan in case being conducted in lieu of building flush-out: Identify:
   1. Testing agency qualifications.
   2. Locations and scheduling of air sampling.
   3. Test procedures, in detail.
   4. Test instruments and apparatus.
   5. Sampling methods.

D. Air Contaminant Test Reports in case being conducted in lieu of building flush-out: Show:
   1. Location where each sample was taken, and time.
   2. Test values for each air sample; average the values of each set of 3.
   3. HVAC operating conditions.
   4. Certification of test equipment calibration.
   5. Other conditions or discrepancies that might have influenced results.

E. Ventilation Effectiveness Test Plan: Identify:
   1. Testing agency qualifications.
   2. Description of test spaces, including locations of air sampling.
   3. Test procedures, in detail; state whether tracer gas decay or step-up will be used.
   4. Test instruments and apparatus; identify tracer gas to be used.
   5. Sampling methods.

F. Ventilation Effectiveness Test Reports: Show:
   1. Include preliminary tests of instruments and apparatus and of test spaces.
   2. Calculation of ventilation effectiveness, E.
   3. Location where each sample was taken, and time.
   4. Test values for each air sample.
   5. HVAC operating conditions.
   6. Other information specified in ASHRAE 129-1997.
   7. Other conditions or discrepancies that might have influenced results.

G. Product Data: Product Data for filtration media used during or after construction or building flush-out.

H. LEED Report: Submit LEED Letter Template with a signature by the general contractor declaring that a Construction IAQ Management Plan has been developed and implemented, and listing each air filter used during construction and at the end of construction, including MERV value, manufacturer name, and model nember. AND EITHER provide 18 photographs, including 6 photographs taken on three different occasions during construction, along with identification of the SMACNA approach featured by each photograph, in order to show consistent adherence to the IAQ requirements, OR declare the five Design Approaches of SMACNA IAQ Guideline for Occupied Buildings under Construction, 1995, Chapter 3, which were used during building

construction, including a brief description of some of the important design approaches employed The LEED Letter Template will be provided by Architect.

1.07 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: Independent testing agency having minimum of 5 years experience in performing the types of testing specified.

PART 2 PRODUCTS

2.01 MATERIALS

A. Low VOC Materials: See other sections for specific requirements for materials with low VOC content.

B. Filtration Media:
   1. During Construction: Minimum Efficiency Reporting Value (MERV) of 8, as determined by ASHRAE 52.2-1999.
   2. Building Flush-Out or Before Occupancy: MERV of 13, as determined by ASHRAE 52.2-1999.

PART 3 EXECUTION

3.01 CONSTRUCTION PROCEDURES

A. Prevent the absorption of moisture and humidity by adsorptive materials by:
   1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
   2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
   3. Provide sufficient ventilation for drying within reasonable time frame.

B. Begin construction ventilation when building is substantially enclosed.

C. If extremely dusty or dirty work must be conducted inside the building, shut down HVAC systems for the duration; remove dust and dirt completely before restarting systems.

D. HVAC equipment and supply air ductwork may be used for ventilation during construction:
   1. Operate HVAC system on 100 percent outside air, with 1.5 air changes per hour, minimum.
   2. Ensure that air filters are correctly installed prior to starting use; replace filters when they lose efficiency.
   3. Do not use return air ductwork for ventilation.
   4. Seal return air inlets or otherwise positively isolate return air system to prevent recirculation of air; provide alternate return air pathways.

E. Do not store construction materials or waste in mechanical or electrical rooms.

F. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
   1. Inspect duct intakes, return air grilles, and terminal units for dust.
   2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.
   3. Clean tops of doors and frames.
   4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
   5. Clean return plenums of air handling units.
   6. Remove intake filters last, after cleaning is complete.

G. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.

H. Use other relevant recommendations of SMACNA IAQ Guideline for Occupied Buildings Under Construction for avoiding unnecessary contamination due to construction procedures.

3.02 BUILDING FLUSH-OUT

A. Contractor's Option: Either full continuous flush-out OR satisfactory air contaminant testing is required, not both.

B. Perform building flush-out before occupancy.

C. Do not start flush-out until:
   1. All construction is complete.
   2. HVAC systems have been tested, adjusted, and balanced for proper operation.
   3. Inspection of inside of return air ducts and terminal units confirms that cleaning is not necessary.
   4. New HVAC filtration media have been installed.

D. Building Flush-Out: Operate all ventilation systems at normal flow rates with 100 percent outside air for minimum two weeks.
   1. Obtain Owner's concurrence that construction is complete enough before beginning flush-out.
   2. Maintain interior temperature of at least 60 degrees F and interior relative humidity no higher than 60 percent.
   3. If additional construction involving materials that produce particulates or any of the specified contaminants is conducted during flush-out, start flush-out over.
   4. Use filtration media with MERV of 13.

E. Install new HVAC filtration media with MERV of 13 after completion of flush-out and before occupancy or further testing.

3.03 AIR CONTAMINANT TESTING

A. Contractor's Option: Either full continuous flush-out OR satisfactory air contaminant testing is required, not both.

B. Perform air contaminant testing before occupancy in accordance with the United States Environmental Protection Agency's current Protocol for Environmental Requirements, Baseline IAQ and Materials, for Research Triangle Park Campus, Section 01445. A copy can be obtained at www.epa.gov/rpt/new-bldg/environmental/spec.htm.

C. Do not start air contaminant testing until:
   1. All construction is complete, including interior finishes.
   2. HVAC systems have been tested, adjusted, and balanced for proper operation.
   3. New HVAC filtration media have been installed.

3.04 VENTILATION EFFECTIVENESS TESTING

A. Perform ventilation effectiveness testing before occupancy.

B. Do not begin ventilation effectiveness testing until:
   1. HVAC testing, adjusting, and balancing has been satisfactorily completed.
   2. Building flush-out or air contaminant testing has been completed satisfactorily.
   3. New HVAC filtration media have been installed.

C. Test each air handler zone in accordance with ASHRAE 129-1997.

D. If calculated air change effectiveness for a particular zone is less than 0.9 due to inadequate balancing of the system, adjust, and retest at no cost to Owner.

END OF SECTION

SECTION 01780

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Project Record Documents.

B. Operation and Maintenance Data.

C. Warranties and bonds.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.

B. Operation and Maintenance Data:
   1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
   2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   3. Submit 1 copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
   4. Submit three sets of revised final documents in final form within 10 days after final inspection.

C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
   2. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing the date of acceptance as the beginning of the warranty period.

D. LEED Related Documents:
   1. Submit LEED related documents required in other Sections of the specification.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Record information concurrent with construction progress.

C. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

D. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish main floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.
   2. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional information as specified in individual product specification sections.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.

B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

C. Include color coded wiring diagrams as installed.

D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include manufacturer's printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide control diagrams by controls manufacturer as installed.

K. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

N. Include test and balancing reports.

O. Additional Requirements: As specified in individual product specification sections.

3.05 OPERATION AND MAINTENANCE MANUALS

A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

B. Prepare data in the form of an instructional manual.

C. Binders: Commercial quality, 8-1/2 x 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.

F. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

G. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Manual: Bind in commercial quality 8-1/2 x 11 inch three D side ring binders with durable plastic covers.

F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.

G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.

H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION

SECTION 01810 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Owner's Project Requirements and Basis of Design documentation prepared by Owner and Architect contains requirements that apply to this Section.

C. ASHRAE Guideline 0-2005 The Commissioning Process

D. ASHRAE Guideline 1-1996 The HVAC Commissioning Process

E. ASHRAE Guideline 4-1993 - Preparation of O&M Documentation for Building Systems

1.2 SUMMARY

A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.

B. The fundamental objectives of the Commissioning Process (Per ASHRAE Guideline 0 2005 The Commissioning Process) are to:

1. Clearly document Owner's Project Requirements.
2. Provide documentation and tools to improve the quality of deliverables.
3. Verify and document that systems and assemblies perform according to the Owner's Project Requirements.
4. Verify that adequate and accurate system and assembly documentation is provided to the owner.
5. Verify that operation and maintenance personnel and occupants are properly trained.
6. Provide a uniform and effective process for delivery of construction projects.
7. Deliver buildings and construction projects that meet the owner's needs, at the time of completion.
8. Utilize quality-based sampling techniques to detect systemic problems, as such sampling provides high value, efficient verification, accurate results, and reduced project costs.
9. Verify proper coordination among systems and assemblies, and among all contractors, subcontractors, vendors, and manufacturers of furnished equipment and assemblies.

C. Commissioning Responsibilities are summarized in the following paragraphs:

1.5 OWNER'S OR OWNER'S REPESENTATIVE RESPONSIBILITIES

1.6 ARCHITECT'S RESPONSIBILITIES

1.7 ENGINEER'S RESPOSIBILITIES
1.8 CONTRACTOR'S RESPONSIBILITIES
1.9 COMMISSIONING AUTHORITY'S RESPONSIBILITIES

1.3 DEFINITIONS

A. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they will mean "record" systems, subsystems, and equipment.

B. TAB: Testing, Adjusting, and Balancing.

C. Acceptance - A formal action to declare that some aspect of the project meets defined requirements, thus permitting subsequent activities to proceed.

D. Approval - Acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the contract documents.

E. Basis of Design - A document produced by the Architect and Engineers that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes:

1. A narrative statement of design describing how the designer intends to meet the Owner's Project Requirements. This narrative includes performance requirements for commissioned systems.
2. A narrative statement of operation that details how the facility is expected to operate under various situations (such as normal operation, extreme event, emergency).
3. Primary design assumptions.

a. Space use.
b. Redundancy
c. Diversity.
d. Space zoning.
e. Occupancy.
f. Space environmental requirements.

4. Information regarding ambient conditions

a. Climatic
b. Geologic
c. Structural
d. Existing construction

5. Standards.

a. Codes.
b. Guidelines.
c. Regulations.
d. Applicable references.

6. Assumptions regarding usage of the facility

7. Schematics.
8. Energy Goals
9. LEED criteria
10. Specific design methods, techniques, software used
11. A listing of specific manufacturer makes and models used as the basis for drawings and specifications.
12. Lists of individual items that support the design process.

F. Checklists - Verification checklists that are developed and used during all phases of the commissioning process to verify that the owner's project requirements are being achieved.

G. Certificate of Readiness – A document that declares that the commissioned systems are ready for Functional Testing. The Certificate of Readiness will be signed by the Contractor certifying that systems, subsystems, equipment, and associated controls are ready, complete, and suitable to turn over to the owner as 100% complete. If the Commissioning Authority begins Functional Testing, and finds any system is not complete, he will cease testing and return the Certificate of Readiness to the Contractor. The Contractor will take whatever measures are required to ready the systems for testing and will reissue the Certificate of Readiness when the systems are ready for testing. The Contractor will bear all costs of the terminated testing and of preparing the systems for re-testing. Prerequisites for the Certificate of Readiness:

1. The Field Verification Checklists are complete.
2. Test and Balance verification is complete.
3. The A/E process is complete.
4. The automation system (including graphics) is complete.

H. Commissioning Authority - The entity identified by the owner who leads, plans, schedules, and coordinates the commissioning team to implement the commissioning process.

I. Commissioning Issues Log: A formal and ongoing record of problems or concerns and their resolution that have been raised by members of the commissioning team during the course of the commissioning process. The Commissioning Authority will prepare and maintain an issues log that describes design, installation, and performance issues that are at variance with the Owner's Project Requirements, Basis of Design, or Contract Documents. Identify and track issues as they are encountered, documenting the status of unresolved and resolved issues.

1. Creating an Issues Log Entry:

a. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.
b. Assign a descriptive title of the issue.
c. Identify date and time of the issue.
d. Identify test number of test being performed at the time of the observation, if applicable, for cross-reference.
e. Identify system, subsystem, and equipment to which the issue applies.
f. Identify location of system, subsystem, and equipment.
g. Include information that may be helpful in diagnosing or evaluating the issue.
h. Note recommended corrective action.

i. Identify commissioning team member responsible for corrective action.

j. Identify expected date of correction.

k. Identify person documenting the issue.

2. Documenting Issue Resolution:

a. Log date correction is completed or the issue is resolved.

b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.

c. Identify changes to the Owner's Project Requirements, Basis of Design, or Contract Documents that may require action.

d. State that correction was completed and system, subsystem, and equipment are ready for retest, if applicable.

e. Identify persons who corrected or resolved the issue.

f. Identify persons documenting the issue resolution.

J. Commissioning Issues Log Report: On a periodic basis, but not less than for each commissioning team meeting, The Commissioning Authority will prepare a written narrative for review of outstanding issues and a status update of the issues log. The Commissioning Authority will include the following information in the issues log and expand it in the narrative:

1. Issue number and title.
2. Date of the identification of the issue.
3. Name of the commissioning team member assigned responsibility for resolution.
4. Expected date of correction.

K. Commissioning Plan - An overall plan developed by the Commissioning Authority that provides the structure, schedule allocation of resources, documentation, coordination and planning for the commissioning process will include the following:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes. Submittal dates will include the latest date approved submittals must be received without adversely affecting commissioning plan.
2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
3. Identification of systems and equipment to be commissioned.
4. Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.
5. Identification of items that must be completed before the next operation can proceed.
6. Description of responsibilities of commissioning team members.
7. Description of observations to be made.
8. Description of requirements for operation and maintenance training, including required training materials.

9. Schedule for commissioning activities with specific dates coordinated with overall construction schedule.
10. Identification of installed systems, subsystems, and equipment, including design changes that occurred during the construction phase.
11. Process and schedule for completing startup checklists for commissioned systems.
12. Step-by-step procedures for testing systems, subsystems, and equipment with descriptions for methods of verifying relevant data, recording the results obtained, and listing parties involved in performing and verifying tests.

L. Commissioning Process - A quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the owner's project requirements.

M. Commissioning Process Activities - Components of the commissioning process.

N. Commissioning Process Progress Report - A written document produced by the Commissioning Authority that details activities completed as part of the commissioning process and significant findings from those activities that is continuously updated during the course of a project. Usually it is incorporated into the commissioning plan as an ongoing appendix.

O. Commissioning Report: The Commissioning Authority will document results of the commissioning process including unresolved issues and performance of systems, subsystems, and equipment. The commissioning report will indicate whether systems, subsystems, and equipment have been completed and are performing according to the Owner's Project Requirements, Basis of Design, and Contract Documents. The commissioning report will include the following:

1. Lists and explanations of substitutions; compromises; variances in the Owner's Project Requirements, Basis of Design, and Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. This report will be used to evaluate systems, subsystems, and equipment and will serve as a future reference document during Owner occupancy and operation. It will describe components and performance that exceed requirements of the Owner's Project Requirements, Basis of Design, and Contract Documents and those that do not meet requirements of the Owner's Project Requirements, Basis of Design, and Contract Documents. It may also include a recommendation for accepting or rejecting systems, subsystems, and equipment.
2. Owner's Project Requirements and Basis of Design documentation.
3. Commissioning plan.
4. Testing plans and reports.
5. Corrective modification documentation.
6. Commissioning Issues log.
7. Completed test checklists.

8. Listing of off-season tests not performed and a schedule for their completion.

P. Commissioning Team - The individuals who through coordinated actions are responsible for implementing the commissioning process.

Q. Construction Documents - This includes a wide range of documents, which will vary from project to project, with the owner's needs and with regulations, laws, and countries. Construction documents usually include the project manual (specifications), plans (drawings) and general terms and conditions of the contract.

R. Continuous Commissioning Process - A continuation of the commissioning process well into the occupancy and operations phase to verify that a project continues to meet current and evolving owner's project requirements. Continuous commissioning process activities are on-going for the life of the facility. Also see On-Going Commissioning Process.

S. Contract Documents - This includes a wide range of documents, which will vary from project to project, with the owner's needs and with regulations, laws, and countries. Contract documents frequently include price agreements, construction management process, requirements and procedures for submittals, changes, and other construction requirements, timeline for completion, and the construction documents.

T. Coordination Drawings - Drawings showing the work of all trades to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and replacement. These drawings graphically illustrate and dimension manufacturers' recommended maintenance clearances.

U. Control system - A component of environmental, HVAC, security, and fire systems for reporting/monitoring and issuing of commands to/from field devices.

V. Data logging - The monitoring and recording of flows, currents, status, pressures, etc., of equipment using stand-alone data recorders separate from the control system or the trending capabilities of control systems.

W. Deferred Performance Tests - Performance tests that are performed, at the discretion of the Commissioning Authority, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design, or other site conditions that disallow the test from being performed.

X. Deficiency - A condition in the installation or function of a component, piece of equipment, or system that is not in compliance with the contract documents.

Y. Factory Testing - Testing of equipment on-site or at the factory, by factory personnel, with or without an owner's representative present.

Z. Field Verification Checklists: Forms generated by the Commissioning Authority used by the contractor to verify that appropriate components are on-site, correctly installed, started properly and functional. It ensures that Functional Testing (in-depth system checkout) may proceed without unnecessary delays. The Commissioning Authority will develop field verification checklists for each piece of commissioned equipment. Specific checklist content requirements are specified in Division 1 Sections pertaining to the specific systems to be commissioned. A failure rate of 10% or greater for any piece of equipment or system will result in the Field

Verification process being repeated for the failed system or piece of equipment. The Contractor will bear the cost of this process. The following items describe these checklists:

1. The Field Verification Checklists are provided by the Commissioning Authority minus the start-up procedures.
2. The Contractor will submit start-up procedures to the Commissioning Authority for approval. These procedures will be from the equipment manufacturer whenever possible.
3. The Commissioning Authority will incorporate the start-up procedures into the Field Verification Checklists and issue the revised checklist to the Contractor
4. Each Field Verification Checklist form may have more than one trade responsible for its execution.
5. Each Field Verification Checklist will include the following:

a. Name and identification code of item.
b. Provide space for installing personnel to sign off on each checklist.
c. Time and date of test.
d. Indication of whether the record is for a first test or retest following correction of a problem or issue.
e. Dated signatures of the person performing test and of the witness, if applicable.
f. Individuals present for test.
g. Technical items to be checked.
h. Pass/Fail indication.
i. Commissioning Issue number, if any, generated as the result of test.
j. Start-up procedures

AA. Functional Tests - Tests performed on complete systems to determine through dynamic testing compliance with the Owner's Project Requirements, The Basis of Design and the Contract documents. These tests are designed, witnessed and evaluated by the Commissioning Authority and are performed by the Contractor. The Commissioning Authority will develop Functional Tests for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested. Prepare separate tests for each mode of operation and provide space to indicate whether the mode under test responded as required. Provide space for testing personnel to sign off on each checklist. Additional specific checklist requirements are specified in Division 1 Sections pertaining to the specific systems to be commissioned. Each checklist, regardless of system, subsystem, or equipment being tested, will include the following:

1. Name and identification code of tested item.
2. Test number.
3. Time and date of test.
4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
5. Dated signatures of the person performing test and of the witness, if applicable.
6. Individuals present for test.

7. Deficiencies.
8. Issue number, if any, generated as the result of test.

BB. Index of Commissioning Documents: The Commissioning Authority will prepare an index to include all commissioning documents.

CC. Nominal Group Technique - A formal, structured brainstorming process used to obtain the maximum possible ranked input from a variety of viewpoints in a short period of time. The typical approach is a workshop session where a question is presented, the attendees each record their responses on a piece of paper, the individual responses are recorded on a flip chart without discussion in a round robin fashion, all of the responses are discussed, and the participants rank their top five responses.

DD. Non-Compliance - See Deficiency.

EE. Non-Conformance - See Deficiency.

FF. Non-Compliance Form – Document produced by the Commissioning Authority to inform the Commissioning Team concerning non-conformance or deficiencies. This form may be the Commissioning Issues Log for simple issues or it may be a more detailed form for complex issues.

GG. On-Going Commissioning Process - A continuation of the commissioning process well into the occupancy and operations phase to verify that a project continues to meet current and evolving owner's project requirements. On-going commissioning process activities occur throughout the life of the facility. Some of these will be close to continuous in implementation, and others will be either scheduled or unscheduled (as needed). Also see Continuous Commissioning Process.

HH. Owner's Project Requirements - A written document that details the functional requirements of a project and the expectations of how it will be used and operated. This includes project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

II. Over-ridden Value - Riding over a sensor value in the equipment's controls to observe the response of the equipment's operation. Also see Simulated Signal.

JJ. Phased Commissioning - Commissioning that is completed in phases as required by the phasing plan as approved for the project and other scheduling issues.

KK. Quality Based Sampling - A process for evaluating a sub-set (sample) of the total population. The sample is based upon a known or estimated probability distribution of expected values; an assumed statistical distribution based upon data from a similar product, assembly, or system; or a random sampling that has scientific statistical basis.

LL. Re-Commissioning - An application of the commissioning process requirements to a project that has been delivered using the commissioning process. This may be a scheduled re-commissioning developed as part of an ongoing commissioning process, or it may be triggered by use change, operations problems, or other needs.

MM. Retro-Commissioning -The commissioning process applied to an existing facility that was not previously commissioned. This guideline does not specifically address retro-commissioning.

However, the same basic process needs to be followed from pre-design through occupancy and operations to optimize the benefits of implementing the commissioning process philosophy and practice.

NN. Seasonal Performance Tests - Performance tests that are deferred until the systems will experience conditions closer to their design conditions based on weather conditions.

OO. Simulated Condition - Condition that is created for the purpose of testing the response of a system (e.g., raising/lowering the setpoint of a thermostat to see the response in a VAV box).

PP. Simulated Signal - Disconnecting a sensor and using a signal generator to simulate a sensor value for the purpose of testing a full range of conditions.

QQ. Startup - The initial starting or activating of dynamic equipment, including completing construction checklists.

RR. Startup Plan. The Contractor will generate a schedule to plan equipment startups. The start-ups will follow the start-up portion of the Field Verification Checklists. The Contractor will submit this plan to the Commissioning Authority for approval before any startup of equipment can be accomplished.

SS. Systems Manual: A system-focused composite document that includes the operation manual, maintenance manual and additional information of use to the owner during the occupancy and operations phase. The Commissioning Authority will gather required information and compile systems manual. Systems manual will include the following:

1. The Owner's Project Requirements and Basis of Design, including system narratives, schematics, and changes made throughout the Project.
2. Project Record Documents as specified in Division 1 Section "Project Record Documents."
3. Final commissioning plan.
4. Commissioning report.
5. Operation and maintenance data as specified in Division 1 Section "Operation and Maintenance Data."

TT. Test and Balance Report. A report generated according to the Specification requirements certifying the performance of the installed systems. This report is submitted to the Commissioning Authority for approval and verification. The Commissioning Authority's review is parallel to the A/E review and does not alter the A/E scope or responsibility.

UU. Test and Balance Verification.

1. Test and Balance Subcontractor will coordinate with The Commissioning Authority for work required. The Test and Balance Subcontractor will copy The Commissioning Authority with required reports, sample forms, checklists, and certificates.
2. The Commissioning Authority will witness 8 hours of Test and Balance Work.
3. Verification of the Final Test and Balance Report:

a. The Commissioning Authority will select, at random, 25 percent of the Final Test and Balance Report for field verification.

b. The Commissioning Authority will notify Test and Balance Subcontractor 5 days in advance of the date of field verification; however, notice will not include data points to be verified. The Test and Balance Subcontractor will use the same instruments (by model and serial number) that were used when original data were collected.

c. Failure of an item is defined as follows:

1) For all readings other than sound, a deviation of more than 10 percent.

2) For sound pressure readings, a deviation of 3 dB. (Note: Variations in background noise must be considered.)

d. Failure of more than 10 percent of selected items will result in rejection of final Test and Balance report. The cost of re-testing will be born by the Contractor

4. If deficiencies are identified during verification testing, The Commissioning Authority will notify the Contractor and Architect. The A/E will review final tabulated checklists and data sheets to determine if verification is complete and that system is operating according to the Contract Documents.

5. The Commissioning Authority will certify that Test and Balance Work has been successfully completed.

VV. Test Procedure - A written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

1. The test procedures are specified in the Technical Specifications sections of the contract documents.

2. Performance testing covers the dynamic functions and operations of equipment and systems using manual or monitoring methods. Systems are tested under various modes, such as during low cooling loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.

3. The systems are run through all the control system's sequences of operation and components are verified to respond as the sequences state.

4. Before test procedures are finalized, the contractor will provide to the A/E and the Commissioning Authority all requested documentation and a current list of changes affecting equipment or systems, including an updated point list, control sequences.

5. Using the requirements in the technical specifications, the Commissioning Authority will develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system.

6. The Contractor will provide assistance to the Commissioning Authority in developing the final procedures. Prior to finalization, the A/E will review and approve the test procedure.

WW. Training Plan - A written document that details the expectations, schedule, budget, and deliverables of commissioning process activities related to training of project operating and maintenance personnel, users, and occupants.

XX. Verification - The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner's Project Requirements.

YY. Trending – The monitoring, by a building management system or other electronic data gathering equipment, and analyzing of the data gathered over a period of time.

ZZ. Vendor - Supplier of equipment.

AAA. Warranty Period - Refer to Division 1 requirements

1.4 COMMISSIONING TEAM

A. Members Appointed by Contractor: Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team will consist of:

1. Project Manager
2. Project Superintendent
3. Any subcontractors, installers, suppliers, and specialists deemed appropriate by the Commissioning Authority.

B. Members Appointed by Owner:

1. The Commissioning Authority: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. The Owner will engage the Commissioning Authority under a separate contract.
2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

C. All Parties

1. Follow the commissioning plan.
2. Attend initial commissioning meeting and additional meetings as necessary

1.5 OWNER'S OR OWNER'S REPESENTATIVE RESPONSIBILITIES

A. General

1. Facilitate the coordination of the commissioning work by the Commissioning Authority, and, with the Contractor and Commissioning Authority, ensure that commissioning activities are being scheduled into the master schedule
2. Manage the contract of the A/E and of the General Contractor.
3. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including the following:

a. Coordination meetings.

b. Training in operation and maintenance of systems, subsystems, and equipment.

c. Testing meetings.

d. Demonstration of operation of systems, subsystems, and equipment.

4. Provide utility services required for the commissioning process.

B. Documentation

1. Provide the Owner's Project Requirements documentation to the Commissioning Authority and the Contractor for use in developing the commissioning plan; systems manual; operation and maintenance training plan; and testing plans and checklists.
2. Provide the Basis of Design documents, prepared by Architect and approved by Owner, to the Commissioning Authority and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.
3. Review and approve the final Commissioning Plan—Construction Phase
4. Perform the normal review of contractor submittals.
5. Through the A/E, furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the Commissioning Authority.
6. Review and approve the performance test procedures submitted by the Commissioning Authority prior to testing.
7. Review commissioning progress and the Commissioning Issues Log.
8. Provide final approval for individual commissioning tests as completed and passing.
9. Provide final approval for the completion of the commissioning work.

C. Attend a commissioning scoping meeting and other commissioning team meetings as deemed necessary by the Commissioning Authority.

D. Attend an acceptance meeting after the Commissioning Report is finalized to discuss the report findings and lessons learned.

E. Observe and witness startup and performance testing of selected equipment as deemed necessary by the owner or Commissioning Authority.

F. Coordinate the resolution of non-compliance and design deficiencies identified in all phases of commissioning.

G. Seasonal or Deferred Testing

1. Assist the Commissioning Authority as necessary in the seasonal or deferred testing and deficiency corrections required by the specifications.
2. Ensure that any seasonal or deferred testing and any deficiency issues are addressed.

1.6 ARCHITECT'S RESPONSIBILITIES

A. Attend the commissioning scoping meeting and selected commissioning team meetings.

B. Perform normal submittal review, construction observation, record drawing preparation, O&M manual preparation as contracted.

C. Provide Basis of Design documentation for all commissioned systems.

D. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.

E. Prepare and submit final record design intent documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.

F. Attend an Acceptance Meeting after the Commissioning Report is finalized to discuss the report findings and lessons learned.

1.7 ENGINEERS' RESPONSIBILITYS

A. Perform normal submittal review, construction observation, record drawing preparation, etc., as contracted. One site observation should be completed just prior to system startup.

B. Provide the Basis of Design documentation requested for commissioned systems. The designers will assist (along with the contractors) in clarifying the operation and control of commissioned systems in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

C. Attend commissioning scoping meetings and other selected commissioning team meetings as deemed necessary by the Commissioning Authority.

D. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.

E. Prepare and submit the final record design intent and operating parameters documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.

F. From the contractor's record drawings, edit and update one-line diagrams developed as part of the Basis of Design documentation and those provided by the vendor as shop drawings for the commissioned systems.

G. Review and approve the Commissioning Authority Field Verification checklists for major pieces of equipment for sufficiency prior to their use.

H. Review and approve the Functional Test procedure forms for major pieces of equipment for sufficiency prior to their use.

I. Witness testing of selected pieces of equipment and systems as deemed necessary by the engineer or by the Commissioning Authority.

J. Participate in the resolution of non-compliance, non-conformance and design deficiencies identified during commissioning during warranty-period commissioning.

K. Attend an Acceptance Meeting after the Commissioning Report is finalized to discuss the report findings and lessons learned.

1.8 CONTRACTOR'S RESPONSIBILITIES

A. General

1. The Contractor will assign representatives with expertise and authority to act on behalf of the Contractor and schedule them to participate in and perform commissioning team activities
2. Include the cost of commissioning in the total contract price.
3. Ensure that all subcontractors and vendors execute their commissioning responsibilities according to the contract documents.
4. Facilitate the coordination of the commissioning and incorporate commissioning activities (the Commissioning Plan) into the overall project schedule.
5. Accomplish commissioning process test procedures
6. The contractor will provide all tools or the use of tools to start, check-out and test equipment and systems
7. Cooperate with the Commissioning Authority for resolution of issues recorded in the Commissioning Issues Log and the Non-Compliance Forms.
8. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.

B. Meetings

1. Participate in the construction-phase coordination meetings.
2. Participate in the training sessions.
3. Attend an Acceptance Meeting after the Commissioning Report is finalized to discuss the report findings and lessons learned.

C. Attend and participate in commissioning team meetings held as deemed necessary by the Commissioning Authority. Attend an Acceptance Meeting after the Commissioning Report is finalized to discuss the report findings and lessons learned.

D. Documentation

1. Provide copies of all submittals (including all changes) as required in Division 1.
2. Prepare O&M manuals, according to the contract documents, including clarifying and updating the original sequences of operation to record/as-tested conditions.
3. Provide an updated construction schedule to the Commissioning Authority on a monthly basis.
4. Provide equipment start up procedures.
5. Issue the Certificate of Readiness.

6. Ensure that subcontractors correct deficiencies and make necessary adjustments to O&M manuals and record drawings for applicable issues identified in any seasonal testing.
7. Provide all equipment warranties to the Commissioning Authority for approval.
8. Review and approve final commissioning documentation.

E. Startup and Testing

1. No less than 60 days prior to startup of the first piece of major equipment, meet with the Commissioning Authority, Owner's representative, and A/E to finalize the detailed commissioning procedures/ schedule.
2. Coordinate start-ups and testing to provide the Commissioning Authority with a minimum of 48 hours notice.

F. Field Verification

1. Review and accept Field Verification checklists provided by the Commissioning Authority.
2. Complete Field Verification checklists as work is completed and provide to the Commissioning Authority on a weekly basis.
3. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.

G. Functional Tests

1. Review and accept Functional Test checklists provided by the commissioning authority
2. Provide technicians who are familiar with the construction and operation of installed systems.
3. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
4. Coordinate the activities of all sub-contractors and vendors

H. Deferred Testing

1. Provide assistance for seasonal or deferred performance testing, performed by the Commissioning Authority.

I. Provide the training of owner personnel.

1. Videotape and edit training sessions. Employ the services of a professional for the video taping of the training sessions
2. Provide instructors for the training sessions.
3. Provide planning and coordination of the training sessions. Coordinate training requirements with the Commissioning Authority

J. Perform all guarantee work for materials furnished under the contract for the time specified in the contract, including all warranties and curing all latent defects within the time period provided in the contract.

K. Test and Balance:

1. Participate in Test and Balance functions specified the "COMMISSIONING AUTHORITY"S RESPONSIBILITIES" paragraph.
2. Verify the following on the Contract Documents:

a. Accessibility of equipment and components required for Test and Balance Work.

b. Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.

c. Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.

d. Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both Test and Balance and commissioning testing.

e. Air and water flow rates have been specified and compared to central equipment output capacities.

3. Identify discontinuities and omissions in the Contract Documents.
4. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.

L. Vendors

1. Provide all requested submittal data, including detailed startup procedures and specific responsibilities of the owner to keep warranties in force.
2. Assist in equipment testing per agreements with contractor.
3. Include cost of all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing, operating, and maintaining equipment according to these contract documents in the base bid price to the contractor.
4. Provide requested information regarding equipment sequence of operation and testing procedures.
5. Review Field Verification checklists and test procedures for equipment installed by factory representatives.

1.9 COMMISSIOING AUTHORITY'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Coordinate and direct the commissioning activities in a logical, sequential and efficient manner.

C. The Commissioning Authority will verify the execution of the commissioning process

D. Document Reviews

1. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the Owner's Project Requirements and Basis of Design.
2. Review Project Record Documents for accuracy. Request revisions from Contractor to achieve accuracy. Project Record Documents requirements are specified in Division 1.
3. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures
4. Review construction meeting minutes for revisions relating to the commissioning process.
5. Review equipment warranties to ensure that the owner's responsibilities are clearly defined.
6. Review, comment on and approve the Test and Balance Report.

E. Meetings

1. Convene commissioning team meetings as the Commissioning Authority deems necessary for the purpose of coordination, communication, and conflict resolution; discuss progress of the commissioning processes. The Commissioning Authority will prepare and distribute minutes to commissioning team members and attendees within five workdays of the commissioning meeting.
2. At the beginning of the construction phase, conduct an initial construction-phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; Test and Balance Work; and Project completion.
3. Attend selected planning and job-site meetings to obtain information on construction progress.
4. Hold an Acceptance Meeting after the Commissioning Report is finalized to discuss the report findings and lessons learned.

F. Documentation

1. Review, approve and compile the Owner's Project Requirements
2. Review, approve and compile the Basis of Design Documents
3. Develop the Commissioning Plan
4. Develop of Field Verification Checklists
5. Develop of Functional Test Checklists
6. Review and approve the Certificate of Readiness.
7. Record test and inspection reports
8. Certify date of acceptance and startup for each item of commissioned equipment.
9. Recommend approval of systems startup by reviewing startup reports and by selected site observation.
10. Certify equipment for start of warranty periods.

11. Document the corrective action documents
12. Prepare and maintain the Commissioning Issues Log
13. Prepare and maintain Non-Compliance Forms
14. Develop and maintain the Commissioning Report
15. Develop and maintain the Commissioning Progress Report

G. Observation

1. Observe construction and report progress and deficiencies. Observe compliance with the Owner's Project Requirements, Basis of Design, Contract Documents, adequate accessibility for maintenance. This does not relieve the A/E of any scope or responsibility.
2. Witness all or part of the HVAC piping test and flushing procedure, sufficient to be confident that proper procedures were followed. Document this testing and include the documentation in Commissioning Report. Notify owner of any deficiencies in results or procedures. This does not relieve the A/E of any scope or responsibility.

H. Test and Balance Verification (See paragraph 1.3 - Definitions)

I. Field Verification

1. Approve Field Verification Checklist completion by selected site observation and statistical sampling of the checklists.

J. Functional Testing

1. With necessary assistance and review from the Contractor, write the performance test procedures for equipment and systems, including energy management control system trending, stand-alone data logger monitoring or manual performance testing. Submit to the owner, engineer and contractor for review, and approval if required.
2. Coordinate, witness, and recommend approval of Functional Performance tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved
3. Analyze any performance trend logs and monitoring data to verify performance.

K. Seasonal or Deferred Testing

1. Coordinate and supervise required seasonal or deferred testing and deficiency corrections.
2. Return to the site at 10 months into the 12 month warranty period and review with facility staff:

a. The current building operation and the condition of outstanding issues related to the original and seasonal commissioning.
b. Identify problems or concerns they have operating the building as originally intended.
c. Make suggestions for improvements and for recording these changes in the O&M manuals.

d. Identify areas that may come under warranty or under the original construction contract.

e. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

L. Assist in the development of a preventive maintenance plan, a detailed operating plan or an energy and resource management plan or record documentation.

1.10 COMMISSIONING DOCUMENTATION

A. Index of Commissioning Documents: The Commissioning Authority will prepare an index to include storage location of each document.

B. Owner's Project Requirements: See Paragraph 1.3 DEFININTIONS.

C. Basis of Design Document: See Paragraph 1.3 DEFININTIONS.

D. Commissioning Plan: See Paragraph 1.3 DEFININTIONS.

E. Functional Tests: See Paragraph 1.3 DEFININTIONS.

F. Certificate of Readiness: See Paragraph 1.3 DEFININTIONS.

G. Commissioning Issues Log: See Paragraph 1.3 DEFININTIONS.

H. Commissioning Issues Log Report: See Paragraph 1.3 DEFININTIONS

I. Commissioning Report: See Paragraph 1.3 DEFININTIONS

J. Commissioning Progress Report: See Paragraph 1.3 EFININTIONS

K. Systems Manual: See Paragraph 1.3 DEFININTIONS

L. Test and Inspection Reports: The Commissioning Authority will record test data, observations, and measurements on test checklists. Photographs, forms, and other means appropriate for the application will be included with data. The Commissioning Authority will compile test and inspection reports and test and inspection certificates and include them in the systems manual and commissioning report.

M. Corrective Action Documents: The Commissioning Authority will document corrective action taken for systems and equipment that fail tests. Include required modifications to systems and equipment and revisions to test procedures, if any. Retest systems and equipment requiring corrective action and document retest results.

1.11 COMMISSIONING SUBMITTALS

A. Commissioning Plan Pre-final Submittal: The Commissioning Authority will submit two hard copies of pre-final commissioning plan to the Contractor, Owner, and Architect. Present submittal in sufficient detail to evaluate data collection and arrangement process. One copy,

with review comments, will be returned to the Commissioning Authority for preparation of the final construction-phase commissioning plan.

B. Commissioning Plan Final Submittal: The Commissioning Authority will submit two hard copies and two sets of electronically formatted information of final commissioning plan. Deliver one hard copy and one set of discs to Owner, and one to the Architect. The final submittal must address previous review comments. The final submittal will include a copy of the pre-final submittal review comments along with a response to each item.

C. Test Checklists and Report Forms: The Commissioning Authority will submit sample checklists and forms to Contractor quality-control manager and subcontractors for review and comment. Submit two copies of each checklist and report form.

D. Certificates of Readiness: The Contractor will submit Certificates of Readiness to the Commissioning Authority to indicate readiness for testing.

E. Test and Inspection Reports: The Contractor will submit test and inspection reports to the Commissioning Authority. The Commissioning Authority will approve the reports and include them in the commissioning documentation.

F. Corrective Action Documents: The Contractor will submit corrective action documents to the Commissioning Authority. The Commissioning Authority will verify them and include in the commissioning documentation

G. Pre-final Commissioning Report Submittal: The Commissioning Authority will submit two hard copies of the pre-final commissioning report. Include a copy of the preliminary submittal review comments along with The Commissioning Authority's response to each item. The Commissioning Authority will deliver one copy to the Owner and one copy to the Architect. One copy, with review comments, will be returned to the Commissioning Authority for preparation of final submittal.

H. Final Commissioning Report Submittal: The Commissioning Authority will submit two hard copies and two sets of electronically formatted information of the final commissioning report. The Commissioning Authority will deliver one hard copy and one set of discs to the Owner, and one copy to the Architect. The final submittal must address previous review comments and will include a copy of the pre-final submittal review comments along with a response to each item.

1.12 QUALITY ASSURANCE

A. Instructor Qualifications: Factory-authorized service representatives experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.

B. Test Equipment Calibration: Comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments will have been calibrated within six months prior to use.

1.13 COORDINATION

A. Coordinating Meetings: As often as the Commissioning Authority deems necessary the Commissioning Authority will plan and conduct coordination meetings of the commissioning team to review progress on the commissioning plan, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities. The Commissioning Authority will distribute the minutes of this meeting within five working days.

B. Pre-testing Meetings: The Commissioning Authority will plan conduct pretest meetings of the commissioning team to review startup reports, pretest inspection results, testing procedures, testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, subsystem, equipment, and component to be tested. The Commissioning Authority will distribute the minutes of this meeting within five working days.

C. Testing Coordination: The Commissioning Authority will coordinate sequence of testing activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform startup and initial checkout and required performance testing will be provided by the contractor for the equipment being tested. This includes two-way radios, meters, and data recorders.

B. All testing equipment will be of sufficient quality and accuracy to test and/or measure system performance within the tolerances specified in the specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers will have a certified calibration to NIST traceable standards within the past year to an accuracy of 0.5 degree F and a resolution of + or - 0.1 degree F. Pressure sensors will have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment will be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags will be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 Execution of Field Verification Checklists and Startup.

A. Four weeks prior to the scheduled startup, the Contractor will coordinate startup and checkout with Commissioning Authority. The execution and approval of the Field Verification Checklists, startup, and checkout will be directed and performed by the contractor, subcontractor or vendor. Signatures are required of the applicable subcontractors for verification of completion of their work.

B. The Commissioning Authority will observe, the procedures for each piece of primary equipment, unless there are multiple units, in which case a sampling strategy may be used.

C. For lower-level components of equipment, (e.g., sensors, controllers), the Commissioning Authority will observe a sampling of the startup procedures.

D. The subcontractors and vendors will execute startup and provide the Commissioning Authority and A/E, with a signed and dated copy of the completed startup and construction checklists.

E. Only individuals of the contractor (technicians, engineers, tradesmen, vendors, etc.) who have direct knowledge and witnessed that a line item task on the construction checklist was actually performed will check off that item. It is not acceptable for witnessing supervisors to fill out these forms.

3.2 FUNCTIONAL TESTING

A. Requirements. The functional testing will demonstrate that each system is operating according to the documented design intent and contract documents. Functional testing facilitates bringing the systems from a state of individual substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.

B. Coordination and Scheduling. The Contractor will provide sufficient notice, regarding their completion schedule for the construction checklists and startup of all equipment and systems to allow the performance testing to be scheduled. The commissioning team will oversee, witness, and document the performance all equipment and systems. The Contractor will execute the tests. Performance testing will be conducted after the Field Verification Checklists, and startup has been satisfactorily completed. The control system will be sufficiently tested and approved by the Commissioning Authority before it is used, to verify performance of other components or systems. The air balancing and water balancing will be completed before performance testing of air or water-related equipment or systems. Testing proceeds from components to sub-systems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems will be checked.

C. Development of Test Procedures. Before test procedures are finalized, the contractor will provide to the A/E and the Commissioning Authority all requested documentation and a current list of changes affecting equipment or systems, including an updated points list, program code, control sequences, and testing parameters. Using the testing parameters and requirements in the technical specifications, the Commissioning Authority will update/develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each contractor/subcontractor or vendor, as appropriate, will provide assistance to the Commissioning Authority in developing the final procedures. Prior to finalization, the A/E will review and concur with the test procedure.

D. Test Methods.

1. Functional testing and all forms of verification may be achieved by manual testing or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers. The Commissioning Authority may substitute specified methods or require an additional method to be executed other than what

was specified, with the approval of the A/E and owner. The Commissioning Authority will determine which method is most appropriate for tests that do not have a specified method.

2. Simulated Conditions. Simulating conditions will be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
3. Overridden Values. Overriding sensor values to simulate a condition, such as overriding the outside air temperature reading in a control system to be something other than it really is, is acceptable.
4. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overridden values.
5. Altering Setpoints. Rather than overriding sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable.
6. Setup. Each performance test will be performed under conditions that simulate actual conditions as closely as is practically possible. The Contractor assisting the Commissioning Authority in executing the test will provide all necessary materials, system modifications, etc., to produce the necessary flows, pressures, temperatures, etc., necessary to execute the test according to the specified conditions. At completion of the test, the Contractor will return all affected equipment and systems to their approved operating settings.

E. Test Equipment. Refer to Part 2 for test equipment requirements.

F. Problem Solving. The burden of responsibility to solve, correct, and retest malfunctions or failures is with the contractor, with A/E approval.

3.3 Sensor and Actuator Calibration.

A. All field-installed temperature, relative humidity, CO, CO2, refrigerant, O2, and/or pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated.

1. Verify that all locations are appropriate and away from causes of erratic operation.
2. Submit to the Commissioning Authority through the Contractor the calibration methods and results.
3. All test instruments shall have had a certified calibration within the last 6 months to NIST traceable standards, and comply with all local, state and/or federal requirements/certifications, as required.
4. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
5. Provide bench testing as required at the direction of the Commissioning Authority.

B. Sensor Calibration Methods

1. All Sensors

a. Verify that all sensor locations are appropriate and away from causes of erratic operation.

b. Verify that sensors with shielded cable are grounded only at one end.

c. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading, of each other, for pressure.

d. Tolerances for critical applications may be tighter.

2. Sensors without Transmitters - Standard Application.

a. Make a reading with a calibrated test instrument within 6 inches of the site sensor.

b. Verify that the sensor reading (via the permanent thermostat, gage or building automation system is within the tolerances in the table below of the instrument-measured value.

c. If not, install offset in building automation system, calibrate or replace sensor.

3. Sensors with Transmitters - Standard Application.

a. Disconnect sensor.

b. Connect a signal generator in place of sensor.

c. Connect ammeter in series between transmitter and building automation system control panel.

d. Using manufacturer's resistance-temperature data simulate minimum desired temperature.

e. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.

f. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the BAS.

g. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.

h. Reconnect sensor.

i. Make a reading with a calibrated test instrument within 6 inches of the site sensor.

j. Verify that the sensor reading (via the permanent thermostat, gage or building automation system building automation system is within the tolerances in the table below of the instrument-measured value.

k. If not, replace sensor and repeat.

l. For pressure sensors, perform a similar process with a suitable signal generator.

4. Sensors with 10K ohm thermistors

a. Disconnect sensor at building automation system building automation system control panel.

b. Connect ohm meter in parallel across thermistor at the building automation system control panel.

c. Compare resistance readings with factory resistance chart for specific thermistor type.

d. Reconnect sensor.

e. Make a reading with a calibrated test instrument within 6 inches of the site sensor.

f. Verify that the sensor reading (via the permanent thermostat, gage or building automation system building automation system is within the tolerances in the table below of the instrument-measured value.

g. If not, replace sensor and repeat.

5. Valve and Damper Stroke Setup and Check building automation system

a. For all valve and damper actuator positions checked; verify the actual position against the building automation system readout.

b. Set pumps or fans to normal operating mode.

c. Command valve or damper closed, visually verify that valve or damper is closed and adjust output zero signal as required.

d. Command valve or damper open, verify position is full open and adjust output signal as required.

e. Command valve or damper to a few intermediate positions.

6. Closure for heating coil valves

a. Set heating setpoint 20°F above room temperature.

b. Observe valve open.

c. Remove power from the valve and verify that the valve stem and actuator position do not change.

d. Restore to normal

e. Set heating setpoint to 20°F below room temperature

f. Observe the valve close. Restore to normal.

7. Closure for cooling coil valves

a. Set cooling setpoint 20°F above room temperature.

b. Observe the valve close.

c. Remove power from the valve and verify that the valve stem and actuator position do not change.

d. Restore to normal.

e. Set cooling setpoint to 20F below room temperature.

f. Observe valve open. Restore to normal.

Tolerances, Standard Applications

Sensor	Required Tolerance (+/-)	Sensor	Required Tolerance (+/-)
Cooling coil, chilled and condenser water temps	0.4F	Flow rates, water Relative humidity	4% of design 4% of design
AHU wet bulb or dew point	2.0F	Combustion flue temps	5.0F
Hot water coil and boiler water temp	1.5F	Oxygen or CO_2 monitor	0.5 % ppm
Outside air, space air, duct air temps	0.4F	CO monitor	0.05 % ppm

Watthour, voltage & amperage	1% of design	Natural gas and oil flow rate	1% of design
Pressures, air, water and gas	3% of design	Steam flow rate	3% of design
Flow rates, air	10% of design	Barometric pressure	0.1 in. of Hg

3.4 DOCUMENTATION, NON-CONFORMANCE, AND APPROVAL OF TESTS

A. Documentation. The Commissioning Authority will witness and verify the documentation of the results of all performance tests. The Commissioning Authority will complete all documentation for performance testing.

B. Non-Conformance.

1. Corrections of minor deficiencies identified may be made during the tests at the discretion of the Commissioning Authority. In such cases the deficiency and resolution will be documented on the procedure form or on an attached sheet.

a. As tests progress and a deficiency is identified, the Commissioning Authority will discuss the issue with the commissioning team, and the contractor.

b. When there is no dispute on the deficiency and the contractor accepts responsibility to correct it:

1) The Commissioning Authority will document the deficiency and the contractor's response and intentions. The Commissioning Authority will submit non-compliance reports to the Contractor. The contractor will correct the deficiency, sign the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and send it to the Commissioning Authority.

2) The contractor will reschedule the test; and the test repeated. The Contractor will bear the cost of recertification.

c. If there is a dispute about a deficiency, regarding whether or not it is a deficiency:

1) The dispute will be documented on the non-compliance form with the contractor's response.

2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the construction manager.

3) The Commissioning Authority documents the resolution process.

4) Once the interpretation and resolution have been decided, the contractor corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the Commissioning Authority, through the Contractor. The contractor will reschedule the test and the test repeated until satisfactory performance is achieved.

d. The Contractor will bear the cost of retesting a performance test.

e. The Contractor will submit in writing to the Commissioning Authority at least as often as commissioning meetings are being scheduled, the status of each outstanding discrepancy identified during commissioning. Discussion will cover explanations of any disagreement and proposals for their resolutions.

f. The Commissioning Authority retains the original non-conformance forms.

g. Retesting will not be considered a justified reason for a claim of delay or for a time extension by the contractor.

C. Failure Due to Manufacturer Defect. If 10% (or three, whichever is greater) of identical pieces of equipment fail to perform to the contract documents (mechanically or substantively) due to a manufacturing defect, not allowing it to meet its submitted performance specification, all identical units may be considered unacceptable by the A/E or Commissioning Authority. In such case, the contractor will provide the owner with the following:

1. Within one week of notification from the Contractor, the contractor or manufacturer's representative will examine all other identical units making a record of the findings. The findings will be provided to the Contractor within two weeks of the original notice.
2. Within two weeks of the original notification, the Contractor or manufacturer will provide a signed and dated, written explanation of the problem, cause of failures, etc., and all proposed solutions. The proposed solutions will not significantly exceed the specification requirements of the original installation.
3. The A/E will determine whether a replacement of all identical units or a repair is acceptable.
4. Two examples, where applicable, of the proposed solution will be installed by the contractor and the A/E will be allowed to test the installations for up to one week, upon which the A/E will decide whether to accept the solution.
5. Upon acceptance, the contractor and/or manufacturer will replace or repair all identical items, at their expense. The replacement/repair work will proceed with reasonable speed beginning within one week from when parts can be obtained.

D. Approval. The Commissioning Authority notes each satisfactorily demonstrated function on the test form. Final approval of the performance test by the owner is made after review by the Commissioning Authority and Contractor, following recommendations by the A/E.

3.5 DEFERRED TESTING

A. Unforeseen Deferred Tests. If any check or test cannot be completed due to the project completion level, required occupancy condition or other deficiency, execution of checklists and performance testing may be delayed upon approval of the Commissioning Authority and Contractor. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.

B. Seasonal Testing. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) will be completed as part of this contract. The Commissioning Authority will coordinate this activity through the Contractor. Tests will be

executed, documented by the Commissioning Authority and deficiencies should be corrected by the Contractor with the Commissioning Authority witnessing. Any final adjustments to the O&M manuals and records due to the testing will be made by the contractor.

END OF SECTION 01810

SECTION 01811 - HVAC COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Owner's Project Requirements, Basis of Design, and Basis of Design-HVAC documentation prepared by Owner and Architect contain requirements that apply to this Section.

B. Division 1 Section 01810 General Commissioning Requirements

1.2 SUMMARY

A. This Section includes requirements for commissioning the HVAC system and its subsystems and equipment. This Section supplements the general requirements specified in Division 1 Section "General Commissioning Requirements."

B. HVAC systems to be tested:
   1. heat pumps
   2. energy recovery unit
   3. geothermal pumping and piping system
   4. exhaust fans
   5. unit heaters
   6. rainwater collection system
   7. solar water heating system with boiler and pump
   8. lighting system

1.3 DEFINITIONS (See Division 1 Section 01810 General Commissioning Requirements)

1.4 CONTRACTOR'S RESPONSIBILITIES

A. The following responsibilities are in addition to those specified in Division 1 Section 01810 General Commissioning Requirements.

B. Contractor:
   1. Attend procedures meeting for TAB Work.
   2. Attend TAB verification testing.
   3. Certify that TAB Work is complete.

4. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.

C. With the Commissioning Authority, review control designs for compliance with the Owner's Project Requirements and Basis of Design, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions.

1.5 COMMISSIONING DOCUMENTATION

A. The following are in addition to documentation specified in Division 1 Section 01810"General Commissioning Requirements."

B. Field Verification Checklists: The Commissioning Authority shall develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems. The Commissioning Authority shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. In addition to the requirements specified in Division 1 Section 01810 "General Commissioning Requirements," checklists shall include the following:

1. Calibration of sensors and sensor function.
2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.
3. Control sequences for HVAC systems.
4. Responses to control signals at specified conditions.
5. Sequence of responses to control signals at specified conditions.
6. Electrical demand or power input at specified conditions.
7. Expected performance of systems, subsystems, and equipment at each step of test.
8. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.
9. Interaction of auxiliary equipment.
10. Point by point check-out of the Building Automation System

1.6 SUBMITTALS

A. The following submittals are in addition to those specified in Division 1 Section 01810 "General Commissioning Requirements."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Prerequisites for Functional Testing:

1. Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, tested, and started; are operating according to the Owner's Project Requirements, Basis of Design, and Contract Documents; and that Certificates of Readiness are signed and submitted.
2. Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the Owner's Project Requirements, Basis of Design, and Contract Documents; and that pretest set points have been recorded.
3. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
4. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.
5. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.
6. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
7. Annotate checklist or data sheet when a deficiency is observed.
8. Verify equipment interface with monitoring and control system and TAB criteria; include the following:
   a. Supply and return flow rates for VAV and constant volume systems in each operational mode.
   b. Operation of terminal units in both heating and cooling cycles.
   c. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
   d. Building pressurization.
   e. Total exhaust airflow and total outdoor-air intake.
   f. Operation of indoor-air-quality monitoring systems.
9. Verify proper responses of monitoring and control system controllers and sensors to include the following:
   a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
   b. Report deficiencies and prepare an issues log entry.

10. Verify that HVAC equipment field quality-control testing has been completed and approved. The Commissioning Authority shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 15 Sections.

11. Testing Instrumentation: Install measuring instruments and/or logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. For individual room cooling tests, provide temporary heaters to impose a cooling load indicated in Basis of Design.

3.2 TESTING

A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

B. Perform tests using design conditions whenever possible.

1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from The Commissioning Authority. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

2. Alter set points when simulating conditions is not practical and when written approval is received from The Commissioning Authority.

3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.

C. Scope of HVAC Testing:

1. Testing scope shall include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. It shall include measuring capacities and effectiveness of operational and control functions.

2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. Detailed Testing Procedures: The Commissioning Authority, with the contractor, shall prepare detailed testing plans, procedures, and checklists for HVAC systems, subsystems, and equipment.

E. HVAC Instrumentation and Control System Testing:

1. Field testing plans and testing requirements are specified in Division 15 Sections "HVAC Instrumentation and Controls. The Commissioning Authority, and the Contractor shall collaborate to prepare testing plans.

2. The Commissioning Authority shall convene a meeting of appropriate entities to review test report of HVAC instrumentation and control systems.

F. Deferred Testing:

1. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.
2. If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.

END OF SECTION 01811

ECTION 01812 - PLUMBING COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Division 1 Section 01810 General Commissioning Requirements

1.2 SUMMARY

A. This Section includes requirements for commissioning the Plumbing system and its subsystems and equipment. This Section supplements the general requirements specified in Division 1 Section 01810 "General Commissioning Requirements."

B. Plumbing systems to be tested:
   1. Solar Water Heating System
   2. Boiler
   3. Pumps

1.3 DEFINITIONS (See Division 1 Section 01810 General Commissioning Requirements)

1.4 CONTRACTOR'S RESPONSIBILITIES (See Division 1 Section 01810 General Commissioning Requirements)

1.5 COMMISSIONING DOCUMENTATION (See Division 1 Section 01810 General Commissioning Requirements)

1.6 SUBMITTALS (Not Used)

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Prerequisites for Functional Testing:
   1. Certify that Plumbing systems, subsystems, and equipment have been completed, calibrated, tested, and started; are operating according to the Owner's Project

Requirements, Basis of Design, and Contract Documents; and that Certificates of Readiness are signed and submitted.

2. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
3. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.
4. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.
5. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
6. Annotate checklist or data sheet when a deficiency is observed.
7. Verify proper responses of monitoring and control system controllers and sensors to include the following:
   a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
   b. Report deficiencies.
8. Verify that Plumbing equipment field quality-control testing has been completed and approved. The Commissioning Authority shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 15 Sections.
9. Testing Instrumentation: Install measuring instruments and/or logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation.

3.2 TESTING

A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

B. Scope of Plumbing Functional Testing:
   1. Functional Testing scope shall include Plumbing system delineated Paragraph 1.2.B. It shall include measuring capacities and effectiveness of operational and control functions.
   2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

C. Deferred Testing:

1. If tests cannot be completed because of a deficiency outside the scope of the Plumbing system, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.
2. If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.

END OF SECTION 01812

SECTION 01813 - ELECTRICAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Owner's Project Requirements, Basis of Design, and Basis of Design-Electrical documentation prepared by the Owner and Architect contains requirements that apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for commissioning the Electrical system and its subsystems and equipment. This Section supplements the general requirements specified in Division 1 Section "General Commissioning Requirements."

1.3 DEFINITIONS (See Section 01810 General Commissioning Requirements)

1.4 CONTRACTOR'S RESPONSIBILITIES

A. The following responsibilities are in addition to those specified in Division 1 Section "General Commissioning Requirements."

B. Electrical Subcontractor:

1. Contractor shall pay for all required testing staff, and all required manufacturer's start up and testing personnel.

2. With the Mechanical Subcontractor, coordinate installations and connections between and among electrical and HVAC systems, subsystems, and equipment.

1.5 COMMISSIONING DOCUMENTATION

A. The following are in addition to documentation specified in Division 1 Section "General Commissioning Requirements."

B. Test Checklists: The Commissioning Authority will develop test checklists for Electrical systems, subsystems, and equipment, including interfaces and interlocks with other systems. The Commissioning Authority will prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. In addition to the requirements specified in Division 1 Section "General Commissioning Requirements," checklists will include, but not be limited to, the following:

1. Calibration of sensors and sensor function for the daylighting system.

2. Control sequences.

3. Electrical demand or power input at specified conditions.

4. Interaction of auxiliary equipment.

1.6 SUBMITTALS

A. The following submittals are in addition to those specified in Division 1 Section "General Commissioning Requirements."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING

A. Scope of Electrical Subcontractor Testing:

1. Testing scope shall include the entire electrical installation, including but not limited to, daylighting, daylighting controls, interior and exterior lighting controls, power metering system.

2. Detailed Testing Procedures: The Commissioning Authority, with Electrical Subcontractor, will prepare detailed testing plans, procedures, and checklists for Electrical systems, subsystems, and equipment.
   a. Electrical systems to be tested:
      1) Power metering
      2) Exterior lighting system and controls
      3) Interior lighting system and controls

3. The following demonstrations will be required:
   a. Interior and Exterior Lighting System Performance:
      1) Interior and Exterior Lighting Systems.
         a) All luminaire/lamp combinations shall be verified by inspection. All incorrectly lamped lights shall be compiled in a list form titled "Incorrect Luminaire Lamping." List shall include room name locations of incorrect lluminaires.
         b) Operational tests shall be performed for all interior and exterior lighting controls, dimming controls, occupancy sensors, photocell sensors, and other lighting control systems.
         c) Interior Lighting Control performance shall be verified, including Operation of Occupancy Sensors, Automatic Time Controls, Energy Management Control Override Timers, Manual Dimming Control, Multi-level Switching, and daylighting.

END OF SECTION 01813

SECTION 01820

DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.

B. Training of Owner personnel in operation and maintenance is required for:
   1. All software-operated systems.
   2. HVAC systems and equipment.
   3. Plumbing equipment.
   4. Electrical systems and equipment.
   5. Items specified in individual product Sections.

C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
   1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
   2. Finishes, including flooring, wall finishes, ceiling finishes.
   3. Fixtures and fittings.
   4. Items specified in individual product Sections.

1.02 RELATED SECTIONS

A. Section 01780 - Closeout Submittals: Operation and maintenance manuals.

B. Section 01810 - Commissioning: Additional requirements applicable to demonstration and training.

C. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures; except:
   1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
   2. Submit one copy to the Commissioning Authority, not to be returned.
   3. Make commissioning submittals on time schedule specified by Commissioning Authority.
   4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, Microsoft Word 2003 preferred.

B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
   1. Submit to Architect for transmittal to Owner.
   2. Submit to Commissioning Authority for review and inclusion in overall training plan.
   3. Submit not less than four weeks prior to start of training.
   4. Revise and resubmit until acceptable.
   5. Provide an overall schedule showing all training sessions.
   6. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. Name of firm and person conducting training; include qualifications.
      d. Intended audience, such as job description.
      e. Objectives of training and suggested methods of ensuring adequate training.
      f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
      g. Media to be used, such a slides, hand-outs, etc.

h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
1. Include applicable portion of O&M manuals.
2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
3. Provide one extra copy of each training manual to be included with operation and maintenance data.

1.04 QUALITY ASSURANCE

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

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.

C. Demonstration may be combined with Owner personnel training if applicable.

D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
1. Perform demonstrations not less than two weeks prior to Substantial Completion.
2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.

B. Conduct training on-site unless otherwise indicated.

C. Owner will provide classroom and seating at no cost to Contractor.

D. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.

E. Provide training in minimum two hour segments.

F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.

G. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule

training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
   1. The location of the O&M manuals and procedures for use and preservation; backup copies.
   2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
   3. Typical uses of the O&M manuals.

I. Product- and System-Specific Training:
   1. Review the applicable O&M manuals.
   2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
   3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
   4. Provide hands-on training on all operational modes possible and preventive maintenance.
   5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
   6. Discuss common troubleshooting problems and solutions.
   7. Discuss any peculiarities of equipment installation or operation.
   8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
   9. Review recommended tools and spare parts inventory suggestions of manufacturers.
   10. Review spare parts and tools required to be furnished by Contractor.
   11. Review spare parts suppliers and sources and procurement procedures.

J. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

SECTION 02280

TERMITE CONTROL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Provide soil treatment for termite control as herein specified.
   1. Treat area of new slab on grade construction.
   2. Retreatment and repair is required if subteranean termite activity is discovered during the warranty period. Contractor will re-treat soil and repair or replace damage caused by termite infestation without cost to the Owner. The Pest Control Subcontractor shall pay the entire cost of re-treatment if required by the North Carolina Department of Agriculture or if required to comply with these specifications including the costs of providing access to the soil, repair of resulting damage to concrete, and project delays.

1.03 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's technical data, environmental hazard and material safety data, storage and disposal recommendations and application instructions.

C. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. In addition to requirements of these specifications, comply with the Manufacturer's instructions and recommendations for work, including preparation of the substrate and application.

B. Engage a professional pest control operator, licensed in accordance with regulations of governing authorities for application of soil treatment solution.

1.05 JOB CONDITIONS

A. Restrictions: Do not apply soil treatment solution until excavating, filling and grading operations are completed, except as otherwise required in construction operations.

B. To ensure penetration, do not apply soil treatment to frozen or excessively wet soils or during inclement weather. Comply with handling and application instructions of the soil toxicant manufacturer.

1.06 WARRANTY

A. See Section 01780 - Closeout Submittals, for additional warranty requirements.

B. Furnish a written warranty certifying that applied soil poisoning treatment will prevent infestation of subterranean termites and, that if subterranean termite activity is discovered during warranty period, Contractor will re-treat soil and repair or replace damage caused by termite infestation.
   1. Provide warranty for a period of Ten (10) years from date of treatment, signed by Applicator and Contractor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aventis Environmental Science, Product: Termidor 80WG or approved equal.

B. Substitutions: See Section 01600 - Product Requirements.

2.02 SOIL TREATMENT SOLUTION

A. Use an emulsible concentrate insecticide for dilution with water, specially formulated to prevent infestation by termites. Fuel oil will not be permitted as a dilutant. Provide a solution as recommended by Applicator which is acceptable to Architect and approved for intended application by the Manufacturer and registered and approved by the EPA and the NC Department of Agriculture, Structural Pest Control Division. Use only soil treatment solutions which are not injurious to planting.

B. Contractor shall provide a pesticide that is guaranteed not to contaminate ground water.

PART 3 EXECUTION

3.01 PREPARATION

A. Surface Preparation: Remove foreign matter which could decrease effectiveness of treatment on areas to be treated. Loosen, rake and level soil to be treated, except previously compacted areas under slabs and foundations. Toxicant may be applied before placement of compacted fill under slabs, if recommended by toxicant manufacturer.

3.02 MIXING

A. Mix emulsible concentrate termiticide into solution on site with confirmation by the Owner's testing laboratory.

3.03 APPLICATION

A. Apply in accordance with manufacturer's instructions.

B. Application Rates:
   1. Apply according to Manufacturer's recommendations as approved by the Architect. Recommended treatment rate is 10 gallons per 100 square feet (or as recommended by Manufacturer).
   2. After application, the Contractor shall request soil samples be taken by the North Carolina Department of Agriculture, Structural Pest Control Division (919.733.6100). The pesticide recovery level must meet their minimum requirements prior to proceeding with construction.

C. Allow not less than 12 hours for drying after application before beginning concrete placement or other construction activities or time as recommended by Manufacturer.

D. Post signs in areas of application warning workers that soil poisoning has been applied. Remove signs when areas are covered by other construction.

E. Reapply soil treatment solution to areas disturbed by subsequent excavation or other construction activities following application.

3.04 DISPOSAL OF WASTE MATERIAL

A. Dispose of waste material in accordance with Manufacturer's instructions.

B. State and Federal requirements for disposal must be followed for safe disposal of waste pesticides.

END OF SECTION

SECTION 02621

FOUNDATION DRAINAGE, RADON VENTING, AND FOOTING FORMWORK

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Foundation Drainage and Perimeter Radon Gas Evacuation System.

1.03 RELATED SECTIONS

A. Section 03300 - Cast-in-Place Concrete: Concrete footings.

1.04 REFERENCES

A. ASTM D 2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2003.

B. ASTM E 1465 - Standard Guide for Radon Control Options for the Design and Construction of New Low-Rise Residential Buildings; 1992.

C. ASTM F 405 - Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings; 1997.

D. ASTM F 891 - Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core; 2000.

E. EPA 402-R-94-009 - Model Standards and Techniques for Control of Radon in New Residential Buildings; Environmental Protection Agency; March 1994.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's descriptive literature for system, including all components.

C. Shop Drawings: Indicate layout of system; include all components specified in manufacturer's descriptive literature or installation instructions, and components indicated in contract documents.

D. Test Report: Certified report from independent testing laboratory supporting compliance of radon evacuation system to requirements specified in Quality Assurance.

E. Manufacturer's Instructions: Printed installation instructions for system, including each component indicated in shop drawings.

1.06 QUALITY ASSURANCE

A. Perimeter Radon Evacuation System: Provide products that can be assembled into system that meets requirements of:
   1. ASTM E 1465.
   2. EPA/402/R-94/009.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Linear Components:
   1. Material: Polyvinyl chloride (PVC) containing minimum 10 percent post-consumer recycled

plastic materials, extruded in closed-channel cross-section, with slot perforations along length to permit moisture migration, 12 foot lengths.

2. Load Deflection and Impact Resistance: Comply with requirements of ASTM F 891 for Type PS 25 PVC pipe.
3. Flow Characteristics: Meet or exceed the flow characteristics of 4 inch diameter corrugated polyethylene slotted pipe complying with ASTM F 405, when subjected to 30-7/8 inch pressure head.

B. Fittings: Same material as linear components, extruded or molded in profiles and shapes as required.

C. Accessories:
1. Fasteners: Steel drill screws of length specified in manufacturer's installation instructions.
2. Reinforcing bar: Deformed steel, of diameter specified in manufacturer's installation instructions.

D. Piping Connecting Foundation Drains to Outlets: PVC, ASTM D 2729, of diameter required.

PART 3 EXECUTION

3.01 PREPARATION

A. Lay out capped radon venting system with consideration for future venting work.

3.02 INSTALLATION

A. Lay out capped "T" system to footing footprint indicated on drawings; locate fittings in accordance with manufacturer's instructions and as indicated.

B. Maintain indicated footing widths by installing spacer straps; locate in accordance with manufacturer's instructions and as indicated.

C. Raise top of system to indicated top-of-footing elevations, using reinforcing bars driven through holes in corner couplings into soil; maintain elevations by using grade stakes, located in accordance with manufacturer's instructions and as indicated, driven into soil and screw-fastened to system.

D. Ensure that all required and indicated components are in place, and system is level at indicated top-of-footing elevations, before beginning installation of cast-in-place concrete footings.

E. Installation of cast-in-place concrete footings is specified in Section 03300.

F. Connect drainage piping to system as indicated before placement of drainage fill, specified in Section 02110.

3.03 PREPARATION FOR FUTURE WORK

A. After building is enclosed, the Owner will pay for radon testing from an independent agency. In the event excessive radon levels are found, the Contractor will be directed to prepare a change order to extend the capped "T" to an exterior wall or through the roof.

B. NOTE: The Contractor will be responsible for coordination and extension of the radon vent through the partially completed building. It is the Contractor's responsibility to anticipate possible locations for routing the vent pipe through and around existing construction.

END OF SECTION

SECTION 02630

RAINWATER COLLECTION SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work of this Section.

1.02 SECTION INCLUDES

A. Insulated above ground corrugated glavanized steel rainwater collection cistern with above ground water capacity display and associated accessories. Stored rain water from the cistern will be used for toilet flushing and provide display for observation as shown on the drawings.

1.03 RELATED SECTIONS

A. Section 03300 - Cast-In-Place Concrete: Requirements for concrete foundation.

B. See Division 15 Plumbing Specifications and Drawings

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Plans, sections, & elevations showing all dimensions and details of tank construction. Include location, inverts, and details of all connections. Show reinforcement and steel and concrete structural properties. Show any modular construction connections proposed.

C. Product Data: Provide data on tank and connection fittings.

D. Manufacturer's Installation Instructions: Indicate special procedures for installation.

E. Project Record Documents: Accurately record actual locations and inverts of buried pipe, components, and connections.

1.05 QUALITY ASSURANCE

A. Conform to applicable code and regulations for work of this section.

1.06 PROJECT CONDITIONS

A. Coordinate the work with connections to plumbing, irrigation, and storm water systems as shown on the drawings.

PART 2 PRODUCTS

2.01 RAINWATER COLLECTION TANK

A. Corrugated Galvanized Steel Tank. The tank shall consist of galvanized steel wall sheets, roof panels, one roof panel with inspection hatch standard peak cap, roof ladder angles, anchor clips, and necessary hardware for tank assembly. Water containment system shall consist of a geo-textile pre-liner, a 25 mil vinyl factory welded seam, flexible membrane main liner, liner hangers, sidewall access panel and hardware for liner installation. The tank shall be insulated with 2" rigid board insulation between wall and water containment system.

B. Tank Capacity: Approx. 20,000 gallon, 18 feet diameter and as dimensioned.

2.02 CONNECTING PIPE MATERIALS

A. Pipe Materials: As specified in Division 15.

B. Fittings: Same material as pipe, tee bends, elbows, cleanouts, reducers, ends to suit pipe joint.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building systems and connection invert elevations are as indicated.

3.02 PREPARATION

A. Ream pipe ends and remove burrs.

B. Remove scale and dirt from components before assembly.

C. Establish invert elevations for all components in the system.

D. Provide concrete foundation capable of supporting load of the tank and water.

3.03 TANK INSTALLATION

A. Install water tank and related components on concrete foundation in accordance with manufacturer's instructions.

B. Install pipe and fittings to connect roof drain pipe, supply pipe and overflow to the tank.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section. See Structural Drawings for additional requirements.

1.02 SECTION INCLUDES

A. Concrete formwork.

B. Floors and slabs on grade.

C. Concrete reinforcement.

D. Under-slab Vapor Retarder.

E. Joint devices associated with concrete work.

F. Miscellaneous concrete elements, including equipment pads, light pole bases, thrust blocks, and manholes.

G. Concrete curing.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements & Worksheet

B. Section 01732 - Waste Mamagement Requirements & Worksheet

C. Section 03356 - Concrete Floor Finishing.

D. Section 07900 - Joint Sealers.

1.04 REFERENCES

A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2005.

B. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2005.

C. ASTM A 767/A 767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2005.

D. ASTM C 33 - Standard Specification for Concrete Aggregates; 2003.

E. ASTM C 39/C 39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2004a.

F. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2004a.

G. ASTM C 150 - Standard Specification for Portland Cement; 2004a.

H. ASTM C 330 - Standard Specification for Lightweight Aggregates for Structural Concrete; 2004.

I. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2003.

J. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving

and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004.

K. ASTM E 1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 1996 (Reapproved 2001).

L. ASTM E 1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 1997 (Reapproved 2004).

M. NC Department of Transportation Standard Specification for Roads and Structures, July 2006.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements.

C. Samples: Submit samples of underslab vapor retarder to be used.

D. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction for concrete accessories.

E. LEED Submittals: If wood form materials, including supports, are used, submit relevant LEED Submittal Forms showing content of sustainably harvested wood, salvaged and reused wood, wood fabricated from recovered timber, and locally-sourced wood, as specified in Section 01355. Submit information about the location of manufacturing or harvesting the materials. Submit information about recycled or recovered contents in the materials if any.

F. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

1.06 QUALITY ASSURANCE

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

B. Acquire cement from same source and aggregate from same source for entire project.

C. Follow recommendations of ACI 305R when concreting during hot weather.

D. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

A. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
   1. If Contractor chooses to use wood form materials, these materials need to be sustainably harvested, slavaged, recovered or reused wood.
   2. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
      a. Vegetable based form release only, do not use petroleum solvents such as creosote or diesel oil. Paraffin and waxes shall not be used when a concrete finish is required.
   3. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.02 REINFORCEMENT

A. Maximize recycled content in reinforcement steel.

B. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420).
   1. Deformed billet-steel bars.
   2. Unfinished.

C. Steel Welded Wire Reinforcement: ASTM A 185, plain type.

D. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gage.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C 150, Type I - Normal Portland type.

B. Fine and Coarse Aggregates: ASTM C 33.

C. Fly Ash: ASTM C 618, Class C or F.

D. Water: Clean and not detrimental to concrete.

2.04 CHEMICAL ADMIXTURES

A. Chemical Admixtures: ASTM C 494/C 494M, Type A - Water Reducing, Type B - Retarding, Type C - Accelerating, Type D - Water Reducing and Retarding, Type E - Water Reducing and Accelerating, Type F - Water Reducing, High Range, and Type G - Water Reducing, High Range and Retarding.
   1. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

2.05 ACCESSORY MATERIALS

A. Bonding Agent: ASTM C 1059, Type II acrylic non-redispersable type.

B. Underslab Vapor Retarder: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with ASTM E 1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Single ply polyethylene is prohibited.

C. Vapor Retarder and Joint Tape: Provide Moistop Plus Vapor Retarder and Moistop Tape manufactured by Fortifiber Building Products or approved equal.

D. Non-Shrink Grout: ASTM C 1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Minimum Compressive Strength at 48 Hours: 2,400 psi.
   2. Minimum Compressive Strength at 28 Days: 7,000 psi.

E. Moisture-Retaining Cover: ASTM C 171; regular curing paper, white curing paper, clear polyethylene, white polyethylene, or white burlap-polyethylene sheet.

F. Liquid Curing Compound: ASTM C 309, Type 1, clear or translucent.

G. Sealers:
   1. Water emulsion acrylic.
   2. Sodium silicate.
   3. Penetrating sealer: Low VOC.

2.06 BONDING AND JOINTING PRODUCTS

A. Waterstops: Bentonite/Butyl Type. Provide Waterstop RX manufactured by Cetco Building Materials Group or approved equal.

B. Joint Filler: Nonextruding, resilient asphalt impregnated fiberboard or felt, complying with ASTM D 1751, 1/4 inch thick and full depth of slab less 1/2 inch; tongue and groove profile.

C. Construction Joint Devices: Integral galvanized steel; 16 gauge minimum (.06 inch) thickness, formed to tongue and groove profile, with removable top strip exposing sealant trough, knockout holes spaced at 6 inches, ribbed steel spikes with tongue to fit top screed edge.

D. Sealant and Primer: As specified in Section 07900.

2.07 CONCRETE MIX DESIGN

A. Concrete Strength: Establish required average strength for each type of concrete on the basis of trial mixtures, as specified in ACI 301.
   1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.

C. Normal Weight Concrete:
   1. Compressive Strength, when tested in accordance with ASTM C 39/C 39M at 28 days: 3000 psi.
   2. Fly Ash Content: Maximum 20 percent of cementitious materials by weight.
   3. Water-Cement Ratio: 0.58 maximum (non-air entrained) and 0.46 maximum (air entrained).
   4. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
      a. Ramps, slabs and sloping surfaces: Less than 5"
      b. Reinforced Foundation Systems: Not less than 2" and not more than 5"
      c. Concrete containing HRWR (super-plasticizer): Less than 8" after addition of HRWR to verified 2"-3" slump concrete.
      d. Other concrete: Less than 4"
   5. Total Air Content: 4 percent, determined in accordance with ASTM C 173/C 173M.
      a. Exception: 6 percent air content for exposed exterior conditions.

2.08 MIXING

A. On Project Site: Mix in drum type batch mixer, complying with ASTM C 685. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.

B. Transit Mixers: Comply with ASTM C 94/C 94M.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

E. Install vapor retarder under all interior slabs on grade. Lap joints minimum 6 inches and seal watertight by taping edges and ends.

3.03 INSTALLING REINFORCEMENT

A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

B. Install wire fabric in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire. If chairs are not required or used, insure all wire fabric is pulled to the upper third of the slab at the time of concrete placement.

C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Place concrete for floor slabs in accordance with ACI 302.1R.

C. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

D. Repair underslab vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches and seal watertight.

E. Separate slabs on grade from vertical surfaces with joint filler.

F. Place joint filler in floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

G. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface. Conform to Section 07900 for finish joint sealer requirements.

H. Install joint devices in accordance with manufacturer's instructions.

I. Install construction joint devices in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

J. Apply sealants in joint devices in accordance with Section 07900.

K. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

L. Saw cut joints within 24 hours after placing. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness.

M. Screed floors level, maintaining surface flatness of maximum 1/4 inch in 10 ft.

3.05 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

C. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
   1. Wood float surfaces that will receive quarry tile and ceramic tile with full bed setting system.
   2. Steel trowel surfaces that will receive carpeting, resilient flooring, seamless flooring, thin set quarry tile, and thin set ceramic tile.
   3. Steel trowel surfaces that will be left exposed.

D. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

3.06 CURING AND PROTECTION

A. Comply with requirements of ACI 308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Surfaces Not in Contact with Forms:
   1. Start initial curing as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
   2. Begin final curing after initial curing but before surface is dry.
      a. Moisture-retaining cover: Seal in place with waterproof tape or adhesive.
      b. Curing compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.07 FIELD QUALITY CONTROL

A. NC DOT will conduct acceptance sampling and testing in accordance with Section 700 of the NC DOT Standard Specifications for Roads and Structures, July 2006.

3.08 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by the Engineer. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

C. Repair concrete slab where porosity does not meet Concrete Floor Finishing standard by manufacturer.

3.09 WASTE MANAGEMENT

A. Comply with Section 01355 - LEED Requirements, Section 01732- Waste Management Requirements and Worksheet.

B. Separate, reuse and recycle waste materials in accordance with the Waste Management Plan and to maximum extent economically feasible. Form lumber may be reused on the job for blocking, etc.

C. Before concrete pours. designate locations or uses for excess concrete. Options include:
   1. Additional site paving,
   2. Post footing anchorage,
   3. Swale, riprap reinforcing,
   4. Flowable fill,
   5. Footing bottom, retaining wall footing ballast,
   6. Storm structure covers,
   7. Underground utility pipe kickers,
   8. Storm pipe flared end section,
   9. Toe wash protection and shoulder and toe outfall restraints for temporary erosoin pipes.

D. Before concrete pours, designate a location for cleaning out concrete trucks. Options include:
   1. Company owned site for that purpose (meeting environmental standards).
   2. On-site area to be paved later in Project.

E. Collect reinforcing steel and place in designated area for recycling.

END OF SECTION

SECTION 03356

CONCRETE FLOOR FINISHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface treatment with stain and sealer.

1.02 RELATED SECTIONS

A. Section 03300 - Cast-in-Place Concrete.

B. Section 07900 - Joint Sealers.

1.03 REFERENCES

A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2005.

B. ASTM E 1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 1996 (Reapproved 2001).

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on sealer and concrete stain, including information on compatibility of different products and limitations.

C. Maintenance Data: Provide data on maintenance renewal of applied coatings.

D. LEED Submittals: Submit information about the location of manufacturing and harvesting the raw materials. Submit information about VOC content and natural product content.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

1.06 MOCK-UP

A. Construct mock-up area under conditions similar to those which will exist during actual placement, 10 feet long by 10 feet wide, with coatings applied.

B. Locate where directed.

C. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

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

1.08 PROJECT CONDITIONS

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

1.09 ENVIRONMENTAL REQUIREMENTS

A. Temporary Lighting: Minimum 200 W light source, placed 8 feet above the floor surface, for each 425 sq ft of floor being finished.

B. Temporary Heat: Ambient temperature of 50 degrees F minimum.

C. Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Bio-Based Concrete Floor Stain and Sealer Finishes:
   1. Eco-Safety Product; Product: ECO ProCote; www.ecosafetyproducts.com
   2. AgriStain; Product Concrete Stain: www.agristain.com.
   3. Safety Stain Company; Product Safety Stain II:

2.02 CONCRETE STAIN FINISH

A. Stain Finish: Basis of Design - Eco-Safety's ProCote, Sandstone.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section per manufacturer's requirements.

3.02 FLOOR SURFACE TREATMENT

A. Apply stain to scheduled floor surfaces in accordance with manufacturer's instructions.

B. Apply sealer to scheduled floor surfaces in accordance with manufacturer's instructions.

3.03 TOLERANCES

A. Measure for F(F) and F(L) tolerances for floors in accordance with ASTM E 1155, within 48 hours after slab installation.

B. Finish concrete to achieve the following tolerances:
   1. Exposed to View and Foot Traffic: Ff 50 and Fl 30.

C. Correct the slab surface if tolerances are less than specified.

D. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.04 SCHEDULES - SEE SHEET A1.03 FOR DETAILED LOCATIONS OF FLOOR FINISHES

END OF SECTION

SECTION 04065

MORTAR AND MASONRY GROUT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Mortar for masonry.

B. Grout for masonry.

1.02 RELATED SECTIONS

A. Section 04810 - Unit Masonry Assemblies: Installation of mortar and grout.

B. Section 04852 - Stone Masonry Veneer: Installation of mortar.

C. Section 08110 - Steel Doors and Frames: Grouting steel door frames installed in masonry.

1.03 REFERENCES

A. ASTM C 91 - Standard Specification for Masonry Cement; 2003a.

B. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2004a.

C. ASTM C 270 - Standard Specification for Mortar for Unit Masonry; 2004a.

D. ASTM C 476 - Standard Specification for Grout for Masonry; 2002.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C 270 is to be used. Also include required environmental conditions and admixture limitations.

C. Samples: Submit two samples of mortar, illustrating mortar color and color range.

1.05 DELIVERY, STORAGE, AND HANDLING

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

1.06 ENVIRONMENTAL REQUIREMENTS

A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.

B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Masonry Cement: ASTM C 91, types as scheduled in this section..
   1. Colored mortar: Premixed cement as required to match Architect's color sample.

B. Pigments for Colored Mortar: Iron or chromium oxides with demonstrated stability and colorfastness.
   1. Colors: As required to match Architect's color samples.

C. Water: Clean and potable.

D. Bonding Agent: Latex type.

2.02 MORTAR MIXES

A. Mortar for Unit Masonry: ASTM C 270, Property Specification.
   1. Engineered masonry: Type M.
   2. Masonry below grade and in contact with earth: Type S.
   3. Exterior, loadbearing masonry: Type N.
   4. Interior, loadbearing masonry: Type N.
   5. Interior, non-loadbearing masonry: Type O.
   6. Pointing mortar: Type N with maximum 2 percent ammonium stearate or calcium stearate per cement weight.

B. Stain Resistant Pointing Mortar: One part Portland cement, 1/8 part hydrated lime, and two parts graded (80 mesh) aggregate, proportioned by volume. Add aluminum tristearate, calcium stearate, or ammonium stearate equal to 2 percent of Portland cement by weight.

C. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

2.03 MORTAR MIXING

A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C 270 and in quantities needed for immediate use.

B. Maintain sand uniformly damp immediately before the mixing process.

C. Add mortar color in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.

D. Do not use anti-freeze compounds to lower the freezing point of mortar.

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

F. Use mortar within two hours after mixing at temperatures of 90 degrees F, or two-and-one-half hours at temperatures under 40 degrees F.

2.04 GROUT MIXES

A. Bond Beams and Lintels: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.

2.05 GROUT MIXING

A. Mix grout in accordance with ASTM C 94/C 94M.

B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C 476 for fine and coarse grout.

C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.

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

PART 3 EXECUTION

3.01 PREPARATION

A. Apply bonding agent to existing concrete surfaces.

B. Plug clean-out holes for grouted masonry with block masonry units. Brace masonry to resist wet grout pressure.

3.02 INSTALLATION

A. Install mortar and grout to requirements of section(s) in which masonry is specified.

B. Work grout into masonry cores and cavities to eliminate voids.

C. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.

D. Do not displace reinforcement while placing grout.

E. Remove excess mortar from grout spaces.

3.03 GROUTING

A. Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of contract documents.

B. Low-Lift Grouting:
   1. Limit height of pours to 12 inches.
   2. Limit height of masonry to 16 inches above each pour.
   3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
   4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.

C. High-Lift Grouting:
   1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
   2. Hollow Masonry: Limit lifts to maximum 4 feet and pours to maximum height of 24 feet.
   3. Place grout for spanning elements in single, continuous pour.

END OF SECTION

SECTION 04810

UNIT MASONRY ASSEMBLIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Concrete Masonry Units (Concrete Block).

B. Ceramic Glazed Face Concrete Block.

C. Reinforcement and Anchorage.

D. Flashings.

E. Accessories.

1.03 DESCRIPTION OF WORK:

A. Extent of each type of masonry work is indicated on drawings.
   1. Types of masonry work required include, but not limited to:
      a. Ashlar pattern split face CMU
      b. Glazed CMU, one side or both sides finish
      c. 8" x 16" x 8" concrete block interior, (1 hr. rated)
      d. 8" x 16" x 8" concrete block exterior,

1.04 RELATED SECTIONS

A. Section 01355 - LEED Requirements:

B. Section 01732 - Waste Management:

C. Section 05500 - Metal Fabrications: Loose steel lintels.

D. Section 06100 - Rough Carpentry: Nailing strips built into masonry.

E. Section 07214 - Foamed-in-Place Insulation: Insulation foamed into cavity spaces and masonry unit cores.

F. Section 07840 - Firestopping: Firestopping at penetrations of masonry work.

G. Section 07900 - Joint Sealers: Backing rod and sealant at control and expansion joints.

H. Section 09900 - Paints and Coatings: Block Filler and Finishes

1.05 REFERENCES

A. ASTM C 90-01 - Standard Specification for Loadbearing Concrete Masonry Units; Nov, 2001.

B. ASTM C 129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2003.

C. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

D. NCMA-TEK - Concrete Masonry Radial Walls.

1.06 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturer's product data for each type of masonry unit, accessory,

and other manufactured product, including certifications that each type complies with specified requirements.

C. Samples for Initial Selection Purposes: Submit samples of the following materials:
   1. Unit masonry samples in small scale form showing extent of color and textures available to match existing masonry.

D. Manufacturer's Certificate: Cement supplier shall certify that no hazardous waste is used in the fuel mix or raw materials or that any hazardous waste is neutralized by the manufacturing process and that no additional pollutants are discharged.

E. LEED Report: Submit for recycled/ recovered content and locally harvested and manufactured materials and products.

1.07 QUALITY ASSURANCE

A. Provide masonry units harvested, manufactured and sold within 500 miles from project site.

B. Comply with provisions of ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the contract documents.

C. Fire Rated Assemblies: Conform to applicable code for detailed UL requirements for fire rated masonry construction.

D. Fire Performance Characteristics: Where indicated, provide materials and construction which are identical to those of assemblies whose fire endurance has been determined by testing in compliance with ASTM E 119 by a recognized testing and inspecting organization or by another means, as acceptable to authority having jurisdiction. Provide evidence acceptable to governing authority that proposed construction complies with fire performance requirements.

E. Single Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.

1.08 MOCK-UP

A. Field Constructed Mock-Ups: Prior to installation of masonry work, erect sample wall panels to further verify selections made for color and textural characteristics, matching of sample submittals of masonry units and mortar, and to represent completed masonry work for qualities of appearance, materials and construction. Build mock-ups to comply with the following requirements:
   1. Provide a maximum of 2 sample panels.
   2. Locate mock-ups on site in locations indicated or, if not indicated, as directed or approved by the Architect.

B. Build mock-ups prior to commencement of exposed masonry work for the following types of masonry in sizes of approximately 4' long by 4' high by full thickness, including face and back-up wythes as well as accessories. Build at location and to design indicated or as otherwise directed by the Architect. Adjust until mock-up appearance and workmanship are acceptable to the Architect.
   1. Typical exterior and interior face ashlar pattern concrete masonry wall
   2. Typical glazed concrete masonry wall

C. Mock-up may remain as part of the Work.

1.09 DELIVERY, STORAGE, AND HANDLING

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

B. Architectural Masonry Units are to be shipped on a wooden pallet and shall be delivered to job site covered with a clear 4-mil plastic bag with shrink wrap applied to keep units covered from exposure to weather conditions. The purchasing contractor shall be responsible for re-applying plastic cover to any units that have been uncovered during the course of the workday.

C. Store and handle masonry units to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes.
   1. Limit moisture absorption of concrete masonry units during delivery and until time of installation to the maximum percentage specified for masonry units for the average annual relative humidity as reported by the U.S. Weather Bureau Station nearest project site.

D. Store cementitious materials off the ground, under cover and in dry location.

E. Store aggregates where grading and other required characteristics can be maintained.

F. Store masonry accessories including metal items to prevent deterioration by corrosion and accumulation of dirt.

1.10 PROJECT CONDITIONS

A. Protection of Work: During erection, cover top of walls with waterproof sheeting at end of each day"s work. Cover partially completed structures when work is not in progress.
   1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
   2. Staining: Prevent grout or mortar or soil from staining the face of masonry to be left exposed or painted. Remove immediately grout or mortar in contact with such masonry.
   3. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.
   4. Protect sills, ledges and projections from droppings of mortar.

B. Do not apply uniform floor or roof loading for at least 12 hours after building masonry walls or columns.

C. Do not apply concentrated loads for at least 3 days after building masonry walls or columns.

D. Cold Weather Protection:
   1. Do not lay masonry units which are wet or frozen.
   2. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
   3. Remove masonry damaged by freezing conditions.
   4. Perform the following construction procedures while masonry work is progressing. Temperature ranges indicated below apply to air temperatures existing at time of installation except for grout. For grout, temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintain mixing temperature selected within 10 deg. F (6 deg. C).
      a. 40 deg. (4 deg. C) to 32 deg. F (0 deg. C):
         1) Mortar: Heat mixing water to produce mortar temperature between 40 deg. F (4 deg. C) and 120 deg. F (49 deg. C).
         2) Grout: Follow normal masonry procedures.
      b. 32 deg. F (0 deg. C) to 25 deg. F (-4 deg. C):
         1) Mortar: Heat mixing water and sand to produce mortar temperatures between 40 deg. F (4 deg. C) and 120 deg. F (49 deg. C); maintain temperature of mortar on boards above freezing.
         2) Grout: Heat grout materials to 90 deg. F (32 deg. C) to produce in place grout temperature of 70 deg. F (21 deg. C) at end of work day.
      c. 25 deg. F (-4 deg. C) to 20 deg. F (-7 deg. C):
         1) Mortar: Heat mixing water and sand to produce mortar temperatures between 40 deg. F (4 deg. C) and 120 deg. F (49 deg. C); maintain temperature of mortar on

boards above freezing.
2) Grout: Heat grout materials to 90 deg. F (32 deg. C) to produce inplace grout temperature of 70 deg. F (21 deg. C) at end of work day.
3) Heat both sides of walls under construction using salamanders or other heat sources.
4) Use windbreaks or enclosures when wind is in excess of 15 mph.

d. 20 deg. F (-7 deg. C) and below:
1) Mortar: Heat mixing water and sand to produce mortar temperatures between 40 deg. F (4 deg. C) and 120 deg. F (49 deg. C).
2) Grout: Heat grout materials to 90 deg. F (32 deg. C) to produce inplace grout temperature of 70 deg. F (21 deg. C) at end of work day.
3) Masonry Units: Heat masonry units so that they are above 20 deg. F (-7 deg. C) at time of laying.
4) Provide enclosure and auxiliary heat to maintain an air temperature of at least 40 deg. F (4 deg. C) for 24 hours after laying units.

5. Do not heat water for mortar and grout to above 160 deg. F (71 deg. C).
6. Protect completed masonry and masonry not being worked on in the following manner. Temperature ranges indicated apply to mean daily air temperatures except for grouted masonry. For grouted masonry, temperature ranges apply to anticipated minimum night temperatures.
a. 40 deg. F (4 deg. C) to 32 deg. F (0 deg. C):
1) Protect masonry from rain or snow for at least 24 hours by covering with weather-resistive membrane.
b. 32 deg. (0 deg. C) to 25 deg. F (-4 deg. C):
1) Completely cover masonry with weather-resistive membrane for at least 24 hours.
c. 25 deg. F (-4 deg. C) to 20 deg. F (-7 deg. C):
1) Completely cover masonry with weather-resistive insulating blankets or similar protection for at least 24 hours, 48 hours for grouted masonry.
d. 20 deg. F (-7 deg. C) and below:
1) Except as otherwise indicated, maintain masonry temperature above 32 deg. F (0 deg. C) for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps or other methods proven to be satisfactory. For grouted masonry maintain heated enclosure to 40 deg. F (4 deg. C) for 48 hours.

E. Hot Weather Protection:
1. Cover of shade masonry units and mortar materials and use cool water for mortar whenever ambient air temperature is 90 deg. F or greater.
2. At air temperatures of 85 deg. F or above, if relative humidity is less than 30% or wind is in excess of 15 mph, provide protection by immediately covering newly constructed walls by providing windbreaks or using fog spray to reduce rate of evaporation.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.

B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

1.12 EXTRA MATERIALS

A. See NC DOT Standard Specifications for Roads and Structures, July 2006 for extra material requirements.

B. Provide 50 of interior masonry units and 50 of exterior masonry units of each size for Owner's use in maintenance of project.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of 16 x 8 inches and nominal depths as indicated on the drawings for specific locations.
   2. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, control joint edges, and other detailed conditions.
      a. Outside corners of interior masonry shall be bullnosed corners.
   3. Contain minimum 30% recycled/ recovered materials such as fly ash.
   4. Load-Bearing Units: ASTM C 90, lightweight.
      a. Hollow block, as indicated.
      b. Exposed faces: Manufacturer's standard color and texture where indicated.
      c. Type II: Non-moisture controlled.
      d. Provide custom solid block at exterior transition block, provide ground face block as detailed. Color to be selected from Manufacturer's custom range of colors
   5. Non-Loadbearing Units: ASTM C 129.
      a. Hollow block, as indicated.
      b. lightweight.

B. Glazed Concrete Block Units:
   1. Manufacturers:
      a. Trenwyth Industries, Product: Astra-Glaze-SW Glazed Masonry Units or approved equal.
   2. Colors: General-Oatmeal; Men's Accent-Pastel Blue; Women's Accent-Sunbath; and Wall Base-Ealr Gray.
   3. Special Shapes:
      a. Coved base at all floor transitions
      b. Bullnose corner units at all outside corners.
   4. Contain minimum 30% recycled/ recovered materials such as fly ash.

C. Ashlar Pattern Split Faced Concrete Block Units:
   1. Manufacturers: Adams Products Company, Oldcastle Architectural Products Group; Product: Ashlarstone Masonry Units or equal.
   2. Colors: A917-1 or approved equal.
   3. Sill blocks and other shapes as indicated on Drawings.
   4. Contain minimum 30% recycled/ recovered materials such as fly ash.

2.02 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: ASTM A 615/A 615M Grade 40 (280) deformed billet bars; galvanized.

B. Single Wythe Joint Reinforcement: Ladder type; ASTM A 82 steel wire, hot dip galvanized after fabrication to ASTM A 153/A 153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.

C. Multiple Wythe Joint Reinforcement: Ladder type; fabricated with moisture drip; ASTM A 82 steel wire, hot dip galvanized after fabrication to ASTM A 153/153M, Class B; 0.1875 inch side rods with 0.1875 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.

D. Strap Anchors: bent steel shape, 1/8x2 inch size, hot dip galvanized to ASTM A 153/A 153M, Class B.

E. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not more than 1 inch and not less than 1/2 inch of mortar

coverage from masonry face.

F. Two-Piece Wall Ties: Formed steel wire, adjustable, dovetail anchor type, hot dip galvanized to ASTM A 153/A 153M, Class B.

2.03 FLASHINGS

A. Metal Flashing Materials: Copper / Kraft Paper Laminated Sheet Flashing, as specified in Section 07620.

B. Rubberized Asphalt Flashing: Self-adhering polymer-modified asphalt sheet complying with ASTM D 1970; minimum 0.040 inch total thickness; with cross-linked polyethylene top and bottom surfaces as specified in Section 07620.

2.04 ACCESSORIES

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
   1. Manufacturers:
      a. Dur-O-Wal: www.dur-o-wal.com.
      b. Hohmann & Barnard, Inc: www.h-b.com.
      c. Masonry Reinforcing Corporation of America: www.wirebond.com.
      d. Substitutions: See Section 01600 - Product Requirements.

B. Joint Filler: Closed cell rubber; oversized 50 percent to joint width; self expanding; in maximum lengths available.
   1. Manufacturers:
      a. Dur-O-Wal: www.dur-o-wal.com.
      b. Hohmann & Barnard, Inc: www.h-b.com.
      c. Masonry Reinforcing Corporation of America: www.wirebond.com.
      d. Substitutions: See Section 01600 - Product Requirements.

C. Building Paper: ASTM D 226, Type I ("No.15") asphalt felt.

D. Nailing Strips: Preservative treated softwood, as specified in Section 06100.

E. Weeps: Molded PVC grilles, insect resistant.

F. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

PART 3 EXECUTION

3.01 EXAMINATION

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

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Follow NCMA-TEK Manual for radial walls.

D. Concrete Masonry Units:
   1. Bond: Running, unless otherwise indicated on Drawings.
   2. Coursing: One unit and one mortar joint to equal 8 inches.
   3. Mortar Joints: Concave for exterior; flush for interior.

3.04 PLACING AND BONDING

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

B. Lay hollow masonry units with face shell bedding on head and bed joints.

C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

D. Remove excess mortar and mortar smears as work progresses.

E. Interlock intersections and external corners.

F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

H. Outside corners of interior concrete masonry walls are to be bullnosed except at the floor and ceiling course. At the top and bottom course, the corners should be square to fit resilient tile and acoustic ceilings.

I. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

J. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.

K. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

L. Follow NCMA-TEK Concrete Masonry Radial Walls for installation of masonry in curved or circular configuration.

3.05 WEEPS/CAVITY VENTS

A. Install weeps in veneer and cavity walls at 24 inches on center horizontally above through-wall flashing.

3.06 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.

3.07 REINFORCEMENT AND ANCHORAGE - GENERAL

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

3.08 REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY

A. Install horizontal joint reinforcement 16 inches on center, unless otherwise noted on plans.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Place continuous joint reinforcement in first and second joint below top of walls.

D. Lap joint reinforcement ends minimum 6 inches.

3.09 REINFORCEMENT AND ANCHORAGES - CAVITY WALL MASONRY

A. Install horizontal joint reinforcement 16 inches on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of openings.

C. Place continuous joint reinforcement in first and second joint below top of walls.

D. Lap joint reinforcement ends minimum 6 inches.

E. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Space anchors at maximum of 24 inches horizontally and 24 inches vertically.

F. Reinforce joint corners and intersections with strap anchors 16 inches on center.

3.10 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
   1. Extend flashings full width at such interruptions and at least 4 inches into adjacent masonry or turn up at least 4 inches to form watertight pan at non-masonry construction.
   2. Remove or cover protrusions or sharp edges that could puncture flashings.
   3. Seal lapped ends and penetrations of flashing before covering with mortar.

B. Extend metal flashings through exterior face of masonry and turn down to form drip. Install joint sealer below drip edge to prevent moisture migration under flashing.

C. Extend plastic and laminated flashings to within 1/4 inch of exterior face of masonry.

D. Lap end joints of flashings at least 4 inches and seal watertight with mastic or elastic sealant.

3.11 LINTELS

A. Install loose steel lintels over openings.

B. Refer to Structural Drawings for lintel sizes and bearing requirements.

3.12 GROUTED COMPONENTS

A. Reinforce bond beams with 2, No. 4 bars, 1 inch from bottom web.

B. Reinforce columns with pilasters as shown on Structural Drawings.

C. Lap splices minimum 48 bar diameters.

D. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

E. Place and consolidate grout fill without displacing reinforcing.

F. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.13 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control and expansion joints.

B. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.

C. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

D. Size control joint in accordance with Section 07900 for sealant performance.

E. Form expansion joint as detailed.

3.14 BUILT-IN WORK

A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.

D. Do not build into masonry construction organic materials that are subject to deterioration.

3.15 TOLERANCES

A. Maximum Variation from Alignment of Columns: 1/4 inch.

B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

F. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.

G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.16 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other sections of work to provide correct size, shape,and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.17 CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

3.18 PROTECTION OF FINISHED WORK

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

3.19 WASTE MANAGEMENT

A. Separate and recycle waste materials in accordance with the Waste Management Plan and to the maximum extent economically feasible.

B. Fold up metal banding, flatten, and place in designated area for recycling.

C. Collect wood packing shims and pallets and place in designated area.

D. Place unused mixed mortar in designated locations where lower strength mortar meets the requirements for bulk fill, for example, use as retaining wall footing ballast, cavity fill at grade, or underground utility pipe kickers.

E. Separate masonry waste and place in designated area for use as structural fill or landscape uses.

END OF SECTION

SECTION 04852

STONE MASONRY VENEER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal anchors and accessories.

B. Setting mortar and pointing mortar.

1.02 RELATED SECTIONS

A. Section 04065 - Mortar and Masonry Grout: Setting and pointing mortar.

1.03 REFERENCES

A. ASTM C 270 - Standard Specification for Mortar for Unit Masonry; 2004a.

B. IMIAWC (CW) - Recommended Practices & Guide Specifications for Cold Weather Masonry Construction; International Masonry Industry All-Weather Council; 1993.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Samples: Submit two stone samples illustrating minimum and maximum stone sizes, color range, texture, and markings.

C. LEED Submittal: Submit information of the quarry location, cost and quantity per section 01355 - LEED Requirements.

1.05 MOCK-UP

A. Construct stone wall mock-up, 4 feet long by 4 feet wide, which includes stone anchor accessories, corner condition, and typical control joint.

B. Locate where directed.

C. Mock-up may remain as part of the Work.

1.06 PRE-INSTALLATION MEETING

A. Convene one week before starting work of this section.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Protect stone from discoloration during storage on site.

B. Provide ventilation to prevent condensation from forming on stone.

1.08 PROJECT CONDITIONS

A. Sequence work to coordinate the installation of stone work with installation of adjacent construction.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Requirements: Comply with recommendations of IMIAWC (CW).

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Stone Quarriers:

1. Product: Luckstone (www.luckstone.com), Blue Ridge Thin Stone or approved equal.
2. Substitutions: See Section 01600 - Product Requirements. Product shall be quarried, processed and sold in North Carolina.

2.02 MORTAR

A. Setting Mortar: ASTM C 270, Type S, using the Proportion Method as specified in Section 04065.

2.03 ACCESSORIES

A. Weep/Cavity Vents: Polyethylene tubing.

B. Back Coating:
   1. Cementitious parging of mortar to a minimum thickness of 1/2 inch.

C. Cleaning Solution: Type which will not harm stone, joint materials, or adjacent surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that support work and site conditions are ready to receive work of this section.

B. Verify that items built-in under other sections are properly located and sized.

3.02 PREPARATION

A. Establish lines, levels, and coursing. Protect from disturbance.

B. Clean stone prior to erection. Do not use wire brushes or implements which can mark or damage exposed surfaces.

C. Clean sawn surfaces of rust stains and iron particles.

D. Coat back surfaces not to be in contact with setting mortar with back coating material. Allow coating to cure.

3.03 INSTALLATION

A. Size stone units to fit opening dimensions and perimeter conditions.

B. Wet absorptive stone in preparation for placement to minimize moisture suction from mortar.

C. Arrange stone pattern to provide color uniformity and minimize visual variations, and provide a uniform blend of stone unit sizes.

D. Provide setting and pointing mortar in accordance with Section 04065.
   1. If water is lost by evaporation, re-temper mortar only within two hours after mixing.
   2. At ambient air temperature 80 degrees F and above, use mortar within two hours after mixing; at ambient air temperature below 50 degrees F, use mortar within two-and-one-half hours after mixing.

E. Set stone in full mortar setting bed to fully support stone over bearing surface. Use setting buttons or shims to maintain correct joint width.

F. Install weep/cavity vents in vertical stone joints at 48 inches on center horizontally; immediately above horizontal flashings, above shelf angles and supports, and at top of each cavity space; do not permit mortar accumulation in cavity space.

G. Cover all exposed sheathing with a vapor barrier and attach a galvanized metal lath using screws. Prior to installation of stone veneer, apply a thin scratch coat of mortar to the lath and allow mortar to set.

H. Follow NCMA-TEK Concrete Masonry Radial Walls for installation of stone masonry veneer. Maximum joint width on curved walls shall be 1/2".

3.04 CLEANING

A. Remove excess mortar as work progresses, and upon completion of work.

B. Clean soiled surfaces with cleaning solution.

C. Use non-metallic tools in cleaning operations.

3.05 PROTECTION OF FINISHED WORK

A. During temporary storage on site, at the end of working day, and during rainy weather, cover stone work exposed to weather with non-staining waterproof coverings, securely anchored.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section. See structural drawings for additional requirements.

1.02 SECTION INCLUDES

A. Structural steel framing members including steel tube trusses, support members, sag rods, and struts.

B. Base plates, shear stud connectors and expansion joint plates.

C. Grouting under base plates.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements- Recycled content in steel

B. Section 01732 - Waste Management- Recycling of steel

C. Section 05500 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.04 REFERENCES

A. NC DOT Standard Specifications for Roads and Structures, July 2006.

B. AISC (MAN) - Steel Construction Manual; American Institute of Steel Construction, Inc.; 2005.

C. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc.; 2005.

D. AISC S348 - Specification for Structural Joints Using ASTM A325 or A490 Bolts; 2004.

E. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2005.

F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 1998.

G. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2006.

H. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Ed. 2004).

I. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate framing plan layouts, sections, & details showing profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
   2. Connections not detailed.
   3. Indicate cambers and loads.
   4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.

D. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.

E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

F. LEED Report: Submit for recycled content and locally harvested and manufactured materials and products.

1.06 QUALITY ASSURANCE

A. Do not release steel for fabrication until the shop drawings have been reviewed and approved by the Project Structural Engineer.

B. Fabricate structural steel members in accordance with AISC "Steel Construction Manual."

C. Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented experience.

D. Erector: Company specializing in performing the work of this section with minimum 5 years of documented experience.

E. Qualifications for welding work: Qualify welding processes and welding operators in accordance with AWS 'Standard Qualification Procedure'. All welders employed in work shall have satisfactorily passed AWS qualification tests.

F. Design any connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in North Carolina and/or as approved by the Project Structural Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

A. Structural Steel Beams and Columns: ASTM A 992.

B. Steel Angles and Plates: ASTM A 36/A 36M.

C. Rolled Steel Structural Shapes: ASTM A 992/A 992M.

D. Steel Shapes, Plates, and Bars: ASTM A 242/A 242M high-strength, corrosion-resistant structural steel.

E. Cold-Formed Structural Tubing: ASTM A 500, Grade B.

F. Hot-Formed Structural Tubing: ASTM A 501, seamless or welded.

G. Miscellaneous Steel Shapes: ASTM A 36.

H. Steel Plate: ASTM A 36.

I. Pipe: ASTM A 53/A 53M, Grade B.

J. Shear Stud Connectors: Made from ASTM A 108 Grade 1015 bars.

K. Sag Rods: ASTM A 36/A 36M.

L. Anchor Bolts: ASTM A36.

M. High-Strength Structural Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, medium carbon, plain.

N. Headed Anchor Rods: ASTM A 307, Grade C.

O. High-Strength Anchor Bolts: ASTM A 325, Type 1 medium carbon, plain.

P. Welding Materials: AWS D1.1; type required for materials being welded.

Q. Headed Weld Studs: ASTM A108.

R. Electrodes: E-70 electrodes for all shop and field welding.

S. Grout: Non-shrink, non-metallic aggregate type, complying with ASTM C 1107 and capable of developing a minimum compressive strength of 7,000 psi at 28 days.

T. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction for shop primer, and containing less than 250 grams/liter of VOC complying with South Coast Air Quality Management District (SCAQMD) regulations for touch-up primer for interior use.

U. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, containing less than 250 grams/liter of VOC complying with South Coast Air Quality Management District (SCAQMD) regulations for interior use.

2.02 FABRICATION

A. Shop fabricate to greatest extent possible.

B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.

C. Fabricate connections for bolt, nut, and washer connectors.

D. Develop required camber for members.

2.03 FINISH

A. Prepare structural component surfaces in accordance with SSPC SP No. 7.

B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, or in contact with concrete.

2.04 SOURCE QUALITY CONTROL AND TESTS

A. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with AISC "Allowable Stress Design Specification for Structural Joints Using ASTM A325 or A490 Bolts"..

B. Welded Connections: Visually inspect all shop-welded connections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

A. Surveys: Employ a registered professional engineer or land surveyor for accurate erection of structural steel. Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Architect. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been agreed upon with Architect.

B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

C. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to

foundations and other in-place work.

D. Erect structural steel in compliance with AISC "Code of Standard Practice for Steel Buildings and Bridges".

E. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

F. Field weld components indicated on shop drawings.

G. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts".

H. Do not field cut or alter structural members without approval of Architect.

I. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

J. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.03 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01400.

B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with AISC "Allowable Stress Design Specification for Structural Joints Using ASTM A325 or A490 Bolts", visually inspecting at least 10 percent of bolts at each connection.

C. Welded Connections: Visually inspect 10 percent of all field-welded connections and replace or test suspect welds using one of the following:
   1. Radiographic testing performed in accordance with ASTM E 94.
   2. Ultrasonic testing performed in accordance with ASTM E 164.
   3. Liquid penetrant inspection performed in accordance with ASTM E 165.
   4. Magnetic particle inspection performed in accordance with ASTM E 709.

3.05 WASTE MANAGEMENT

A. Collect cut-offs and scrap and place in designated areas for recycling per Sections 01375 and 01732.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Shop fabricated steel and metal items.

B. Definition: Metal fabrications include items made from iron and steel shapes, plates, bars, strips, tubes, pipes and castings which are not a part of structural steel or other metal systems specified elsewhere.

C. Extent of metal fabrications is indicated on drawings and schedules.

D. Types of work in this section include metal fabrications for:
   1. Loose bearing and leveling plates.
   2. Loose steel lintels.
   3. Miscellaneous framing and supports.
   4. Shelf angles.
   5. Steel bollards.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements - Recycling of metals.

B. Section 01732 - Waste Management - Recycling of metals.

C. Section 03300 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.

D. Section 05120 - Structural Steel

E. Section 09900 - Paints and Coatings: Paint finish.

1.04 REFERENCES

A. NC DOT Standard Specifications for Roads and Structures, July 2006.

B. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 1998.

C. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2006.

D. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

E. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturer"s specifications, anchor details and installation instructions for products used in miscellaneous metal fabrications, including paint products and grout.

C. Shop Drawings: Submit shop drawings for fabrication and erection of miscellaneous metal fabrications. Include plans, elevations and details. Indicate profiles, sizes, connections, attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Provide

templates for anchor and bolt installation by others.

1. Where materials or fabrications are indicated to comply with certain requirements for design loadings include structural computations, show material properties and other information needed or used for structural analysis.
2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

D. LEED Report: Submit for recycled contents and locally harvested and manufactured materials and products.

1.06 QUALITY ASSURANCE

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500, Grade B cold-formed structural tubing.

C. Plates: ASTM A 283.

D. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.

E. Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, galvanized to ASTM A 153/A 153M where connecting galvanized components.

F. Welding Materials: AWS D1.1; type required for materials being welded.

G. Shop and Touch-Up Primer: SSPC-Paint 15, contining less than 250 grams/liter VOC's; comply with South Coast Air Quality Management District (SCAQMD) regulations.

H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Workmanship: Use materials of size and thickness indicated or, if not indicated, as required to produce strength and durability in finished product for use intended. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32" unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts.

G. Provide for anchorage of type shown, coordinated with supporting structure. Fabricate and

space anchoring devices to provide adequate support for intended use.

H. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware and similar items.

I. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

J. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

K. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED ITEMS

A. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.

B. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.

C. Lintels: As detailed; prime paint finish.

D. Door Frames for Overhead Door Openings and Wall Openings: Channel sections; prime paint finish.

2.04 FINISHES - STEEL

A. Prime paint all steel items.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.

C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

D. Prime Painting: One coat.

E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A 123/A 123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.

F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A 123/A 123M requirements.

2.05 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible, do not delay job progress; allow for trimming and fitting where taking

field measurements before fabrication might delay work.

B. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

C. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION

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

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Obtain approval prior to site cutting or making adjustments not scheduled.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.

E. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete masonry or similar construction.

F. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch-up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

G. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

H. Setting Loose Plates: Clean concrete and masonry bearing surfaces of any bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.

I. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with the edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.

J. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain

K. Steel bollards: Install steel bollards in concrete footing as shown on drawings.

L. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

3.05 ADJUST AND CLEAN:

A. Touch-Up Painting: Clean and touch-up paint field welds, bolted connections and abraded areas of the shop paint on miscellaneous metal. See section 09900 for finish painting.

B. For galvanized surfaces: Clean field welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 06100

ROUGH CARPENTRY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Structural roof framing.

B. Roof sheathing with radiant barrier applied to its back side.

C. Preservative treatment of wood.

D. Miscellaneous framing and blocking, including non-structural interior wall framing.

E. Telephone and electrical panel boards.

F. Wood nailers and curbs for roofing and items installed on roof.

G. Concealed wood blocking for support of toilet and bath accessories, wall cabinets, and wood trim.

H. Miscellaneous wood nailers and furring strips.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Forest Stewardship Council Certification Requirements for Wood Products and recycling requirements for wood.

B. Section 01732 - Construction Waste Management - recycling requirements.

C. Section 05500 - Metal Fabrications: Miscellaneous steel connectors and support angles for wood framing.

D. Section 06200 - Finish Carpentry

E. Section 07620 - Sheet Metal Flashing and Trim: Sill flashings.

F. Sections 04810 & 05400: Window openings to receive wood blocking.

1.04 REFERENCES

A. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2004.

B. AWPA C2 - Lumber, Timber, Bridge Ties and Mine Ties -- Preservative Treatment by Pressure Processes; American Wood-Preservers' Association; 2002.

C. AWPA U1 - Use Category System: User Specification for Treated Wood; American Wood-Preservers' Association; 2005.

D. PS 1 - Construction and Industrial Plywood; National Institute of Standards and Technology (Department of Commerce); 1995.

E. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 2005.

F. SPIB (GR) - Grading Rules; Southern Pine Inspection Bureau, Inc.; 2002.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide technical data on wood preservative materials.

C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

D. LEED Submittals: Submit applicable LEED Submittal Form for each different product made of sustainably harvested wood, salvaged and reused wood, wood fabricated from recovered timber, as well as locally-sourced wood, as specified in Section 01355.

E. Certified Lumber:
   1. Submit chain-of custody certificate from one of the certifying organizations listed below, certifying that lumber is harvested from a well managed forest.
      a. Scientific Certification Systems, Inc., Oakland CA.
      b. Smart Wood Certification Program: Rainforest Alliance, New York NY

1.06 QUALITY ASSURANCE

A. Lumber: Comply with PS 20 and approved grading rules and inspection agencies.
   1. Lumber of other species or grades, or graded by other agencies, is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

B. Certified Wood: All wood under this Section must be certified in accordance with the Forest Stewardship Council's (www.fscus.org) guidelines for wood building components.

C. Exposed-to-View Rough Carpentry: Submit manufacturer's certificate that products meet or exceed specified requirements, in lieu of grade stamping.

1.07 INDOOR AIR QUALITY

A. Protect framing from moisture during construction. Allow framing to dry for as long as feasible before enclosing, to reduce conditions favorable to growth of mold. Construct framing assemblies to allow moisture to escape.

B. Avoid wood products containing urea-formaldehyde glues (interior grade plywood and particleboard). Do not use inside the shell of the building.

1.08 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Lumber fabricated from old growth timber is not permitted.

B. Provide sustainably harvested wood; see Section 01600 for requirements.

C. Provide wood harvested within a 500 mile radius of the project site; see Section 01600 for requirements for locally-sourced products.

D. Lumber salvaged from deconstruction or demolition of existing buildings or structures is permitted in lieu of sustainably harvested lumber provided it is clean, denailed, and free of paint and finish materials, and other contamination; identify source; see Section 01600 for requirements for reused products.

E. Lumber fabricated from recovered timber (abandoned in transit) is permitted in lieu of sustainably harvested lumber, unless otherwise noted, provided it meets the specified

requirements for new lumber and is free of contamination; identify source.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: Southern Pine Inspection Bureau, Inc. (SPIB).

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Moisture Content: S-dry or MC19.

D. Stud Framing (2 x 2 through 2 x 6):
   1. Species: Spruce-Pine-Fir.
   2. Grade: Stud.

E. Joist, Rafter, and Small Beam Framing (2 x 6 through 4 x 16):
   1. Species: Spruce-Pine-Fir (South).
   2. Grade: No. 2.

F. Miscellaneous Blocking, Furring, Nailers, and dimension lumber:
   1. Species: Spruce-Pine-Fir or Southern Yellow Pine.
   2. Grade: #2 or better.:
   3. Blocking: Standard or No. 3.

2.03 CONSTRUCTION PANELS

A. APA Rated Roof Sheathing with Radiant Barrier: Exposure 1, FSC certified, and as follows:
   1. Structural 1
   2. Span Rating: 48/24.
   3. Radiant barrier applied to roof sheathing.
      a. LP; TechShield; www.lpcorp.com
      b. Polar-Ply Company; Polar-Ply; www.polar-ply.com
      c. Coastal Plywood Company; Solar Ply; www.coastalplywood.com

B. Wall Sheathing: APA Structural I Rated Sheathing, Exterior Exposure Class, and as follows:
   1. Span Rating: 24/0.
   2. Thickness: 1/2 inch, nominal.

C. Miscellaneous Panels: all plywood products must be FSC certified and urea-formaldehyde free.
   1. Concealed Plywood: PS 1, C-C Plugged, exterior grade.
   2. Exposed Plywood: PS 1, A-D, interior grade.
   3. Electrical Component Mounting: APA rated sheathing, fire retardant treated.

2.04 ACCESSORIES

A. Fasteners and Anchors:
   1. Fasteners: Hot-dipped galvanized steel per ASTM A 153/A 153M steel for high humidity, exterior and treated wood locations, unfinished steel elsewhere.
   2. Anchors: Toggle bolt type for anchorage to hollow masonry.

B. Building Paper: No. 15 asphalt felt.

2.05 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

B. Preservative Pressure Treatment of Lumber Above Grade: AWPA Use Category UC3B, Commodity Specification A (Treatment C2) using waterborne preservative to 0.25 lb/cu ft retention.
   1. Kiln dry lumber after treatment to maximum moisture content of 19 percent.

2. Treat lumber in contact with roofing, flashing, or waterproofing.
3. Treat lumber in contact with masonry or concrete.
4. Treat lumber less than 18 inches above grade.

PART 3 EXECUTION

3.01 FRAMING INSTALLATION

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength.

D. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

E. Install structural members full length without splices unless otherwise specifically detailed.

F. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AFPA Wood Frame Construction Manual.

G. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.

H. Frame openings with two or more studs at each jamb; support headers on cripple studs.

3.02 INSTALLATION OF ACCESSORIES AND MISCELLANEOUS WOOD

A. Coordinate installation of wood blocking with toilet accessory and cabinet locations as shown on the drawings.

B. Coordinate installation of wood decking.

C. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.

D. Coordinate curb installation with installation of decking and support of deck openings.

3.03 INSTALLATION OF CONSTRUCTION PANELS

A. Roof Sheathing: Secure panels perpendicular to framing members, with ends staggered and sheet ends over firm bearing.
   1. Use sheathing clips between roof framing members.
   2. Provide solid edge blocking between sheets.
   3. Nail panels to framing; staples are not permitted.

B. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.

3.04 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.05 CLEANING

A. Waste Disposal: Comply with the requirements of Section 01732.

1. Comply with applicable regulations.
2. Do not burn scrap on project site.
3. Do not burn scraps that have been pressure treated.
4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.

B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

3.06 WASTE MANAGEMENT

A. Separate and handle wood waste in accordance with Sections 01355 and 01732 and the Waste Management Plan.

B. Separate the following categories for salvage or reuse on site:
1. Sheet materials larger than 2 square feet.
2. Framing members larger than 16".
3. Multiple offcuts of any size larger than 12".

C. The following categories may be re-used in the manufacture of particleboard or medium density fiberboard (MDF):
1. Composite wood (for example, plywood, OSB, LVL, I-joist, parallel strand, MDF, particleboard).
2. Clean dimensional lumber.

D. Set aside damaged wood for acceptable alternative uses, for example use as bracing, blocking, cripples or ties.

E. Do not burn lumber or waste material.

F. Separate the following categories for disposal and place in designated areas for hazardous materials:
1. Treated, stained or contaminated wood.

G. Sequence work to minimize use of temporary HVAC to dry out building and control humidity.

END OF SECTION

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SECTION 06176

ENGINEERED WOOD JOISTS AND BEAMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. FSC certified wood I-joists and laminated veneer lumbers for roof framing.

B. Bridging, bracing, and anchorage.

1.02 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Recycling requirements and certification for wood.

B. Section 01732 - Construction Waste Management - recycling requirements.

C. Section 06100 - Rough Carpentry.

1.03 REFERENCES

A. ASTM D 2559 - Standard Specification for Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions; 2004.

B. ASTM D 5055 - Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists; 2004.

C. PS 1 - Construction and Industrial Plywood; 1995.

D. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2004.

E. Forest Stewardship Council: www.fsc.org.

F. Forest Certification Resource Center: www.certifiedwood.org

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's literature describing materials, dimensions, allowable spans and spacings, bearing and anchor details, bridging and bracing requirements, and installation instructions; identify independent inspection agency.

C. Shop Drawings: Indicate sizes and spacing of joists, bracing and bridging, bearing stiffeners, holes to be cut (if any), and framed openings between joists.

D. Certificate: Certification by joist manufacturer that products delivered are of the same design and construction as those evaluated by the independent inspection agency.

E. LEED Report: Submit for sustainably harvested wood, salvaged and reused wood, wood fabricated from recovered timber, and locally-sourced wood, as specified in Section 01355.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in manufacturer's original packaging with manufacturer's name and product identification intact and legible.

B. Protect products from damage due to weather and breakage.

C. Protect joists from warping or other distortion by stacking in upright position, braced to resist movement, with air circulation under coverings and around stacks.

D. Handle individual joists in the upright position.

PART 2 PRODUCTS

2.01 MATERIALS

A. FSC Certified Wood I-Joists: Solid lumber top and bottom flanges and oriented strand board (OSB) webs bonded together with structural adhesive, with published span rating to meet project requirements.
   1. Span Rating: Established and monitored in accordance with ASTM D 5055 by independent inspection agency.
   2. Oriented Strand Board: Comply with PS 2.
   3. Adhesive: Tested for wet/exterior service in accordance with ASTM D 2559.
   4. Depth: As indicated on drawings.
   5. Fabrication Tolerances:
      a. Flange Width: Plus/minus 1/32 inch.
      b. Flange Thickness: Minus 1/16 inch.
      c. Joist Depth: Plus 0, minus 1/8 inch.
   6. Marking: Mark each piece with depth, joist spacing, and allowable span for joist spacing.
   7. Provide bearing stiffeners if required by span rating or joist hanger manufacturer.

B. FSC Certified Laminated Venner Lumbers: Consisting of sheets of wood veneer bonded together with structural adhesive.
   1. Material shall comply with NES Report No. NER-481, ICBO ES Report No. ER-4979 or CCMC Report No. 0875-R.
   2. Minimum Material Properties:
      a. Allowable Bending Stress, Fb: 2600 psi
      b. Allowable Shear Stress (Parallel to Grain), Fv: 285 psi
      c. Modulus of Elasticity: 1900 ksi
   3. Adhesives: Adhesives shall be of the waterproof type conforming to the requirements of ASTM D-2559.
   4. Depth: As indicated on drawings.
   5. Width: 1-3/4"
   6. Fabrication Tolerances:
      a. Finished Length (as specified): Plus/minus 1/8 inch.
      b. Depth: Plus/minus 1/16 inch.
      c. Width: Plus/minus 1/16 inch.

C. Wood-Based Components:
   1. Wood fabricated from old growth timber is not permitted.
   2. Provide sustainably harvested wood, certified or labeled as specified in Section 01600.

D. Joist and beam Hangers: Electrogalvanized steel, type and size recommended by joist and beam manufacturer.

E. Joist Bridging: Type, size and spacing recommended by joist manufacturer.

F. Wood Blocking, Plates, and Opening Framing: Softwood, construction grade, maximum moisture content of 19 percent.

G. Fasteners: Electrogalvanized steel, type to suit application.

H. Bearing Plates: Electrogalvanized steel, unfinished.

I. Hurricane Clips: Electrogalvanized steel, Simpson Strong-tie "H-8".

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that supports and openings are ready to receive joists.

B. Verify that field measurements are as indicated on shop drawings.

3.02 PREPARATION

A. Coordinate placement of bearing items.

3.03 ERECTION

A. Install joists in accordance with manufacturer's instructions.

B. Set structural members level and plumb, in correct position.

C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb, and in true alignment until completion of erection and installation of permanent bracing.

D. Do not field cut or alter structural members without approval of Architect.

E. Place permanent bridging and bracing.

F. Place headers and supports to frame openings required.

G. Frame openings between joists with lumber in accordance with Section 06100.

H. Coordinate placement of decking with work of this section.

3.04 TOLERANCES

A. Framing Members: 1/2 inch maximum, from true position.

END OF SECTION

SECTION 06181

GLUED-LAMINATED STRUCTURAL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. FSC certified glue laminated wood beams.

B. Steel hardware and attachment brackets.

1.02 REFERENCES

A. AITC 117-DESIGN - Standard Specifications for Structural Glued Laminated Timber of Softwood Species; American Institute of Timber Construction; 2004, and errata.

B. AITC A190.1 - American National Standard for Wood Products - Structural Glued Laminated Timber; American Institute of Timber Construction; 2002.

C. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2005.

D. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.

E. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2004.

F. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2004b.

G. ASTM A 325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Tensile Strength (Metric); 2004b.

H. ASTM A 563 - Standard Specification for Carbon and Alloy Steel Nuts; 2004a.

I. ASTM A 563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric); 2004.

J. ASTM D 2559 - Standard Specification for Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions; 2004.

K. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005.

L. SPIB (GR) - Grading Rules; Southern Pine Inspection Bureau, Inc.; 2002.

M. Forest Stewardship Council: www.fsc.org.

N. Forest Certification Resource Center: www.certifiedwood.org.

1.03 DESIGN REQUIREMENTS

A. Design and laminate members in accordance with AITC 117-DESIGN.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate framing system, sizes and spacing of members, loads and cambers, bearing and anchor details, bridging and bracing, framed openings.
   1. Submit design calculations.

C. LEED Report: Submit for sustainably harvested wood, salvaged and reused wood, wood fabricated from recovered timber, and locally-sourced wood, as specified in Section 01355.

D. Certificate of conformance indicating comformance with AITC A190.1-1992.

1.05 QUALITY ASSURANCE

A. Manufacturer/Fabricator: Company specializing in manufacture of glue laminated structural units with three years of documented experience, and certified by AITC in accordance with AITC A190.1.

B. Design Supervision: Design structural members under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in North Carolina.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Protect members to AITC requirements for not wrapped.

B. Leave individual wrapping in place until finishing occurs.

PART 2 PRODUCTS

2.01 MATERIALS

A. Lumber: Southern Yellow Pine lumber certified by Forest Stewardship Council, conforming to SPIB grading rules with 12 percent maximum moisture content before fabrication. Glued-laminated structural unit will be exposed to view and shall not have any stamps or labels on any surfaces when installed. Design for the following values:
   1. Bending (Fb): 2,400 psi.
   2. Tension Parallel to Grain (Ft): 1,150 psi.
   3. Compression Parallel to Grain (Fc): 1,700 psi.
   4. Compression Perpendicular to Grain: 750 psi.
   5. Horizontal Shear (Fv): 200 psi.
   6. Modulus of Elasticity (E): 1,700,000 psi.
   7. Lumber fabricated from old growth timber is not permitted.
   8. Provide sustainably harvested lumber, certified or labeled as specified in Section 01600.
   9. Provide lumber harvested within a 500 mile radius of the project site.

B. Steel Connections and Brackets: ASTM A 36/A 36M weldable quality, galvanize per ASTM A 123/A 123M.

C. Hardware: ASTM A 325 (ASTM A 325M) Type 1 high strength heavy hex bolts and ASTM A 563 (ASTM A 563M) nuts, hot-dip galvanized to meet requirements of ASTM A 153/A 153M, matching washers.

D. Anchor Bolts: ASTM A 325 (ASTM A 325M) Type 1 heavy hex high strength bolts and ASTM A 563 (A 563M) nuts; hot-dip galvanized to meet requirements of ASTM A 153/A 153M, matching washers.

E. Laminating Adhesive: Tested for wet/exterior service in accordance with ASTM D 2559.

F. Bearing Plate Anchors: Expansion shield and lag bolt type for anchorage to solid masonry or concrete.

2.02 FABRICATION

A. Fabricate glue laminated structural members in accordance with AITC Architectural grade.

B. Verify dimensions and site conditions prior to fabrication.

C. Cut and fit members accurately to length to achieve tight joint fit.

D. Do not splice or join members in locations other than those indicated without permission.

E. Fabricate steel hardware and connections with joints neatly fitted, welded, and ground smooth.

F. After end trimming, seal with penetrating sealer in accordance with AITC requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that supports are ready to receive units.

B. Verify sufficient end bearing area.

3.02 PREPARATION

A. Coordinate placement of bearing items.

3.03 ERECTION

A. Lift members using protective straps to prevent visible damage.

B. Set structural members level and plumb, in correct positions or sloped where indicated.

C. Provide temporary bracing and anchorage to hold members in place until permanently secured.

D. Fit members together accurately without trimming, cutting, or other unauthorized modification.

3.04 TOLERANCES

A. Framing Members: 1/2 inch maximum from true position.

END OF SECTION

SECTION 06200

FINISH CARPENTRY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Finish carpentry items, including window trims and sill.

B. Attachment accessories.

1.03 WORK INCLUDED

A. Fabrication and installation of finished carpentry as shown on the drawings. Work items include the following:
   1. Closet and utility shelving.
   2. Miscellaneous wood trim.

1.04 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Forest Stewardship Council Certification of Wood Products; Recycling of wood.

B. Section 01732 - Construction Waste Management - Recycling of wood.

C. Section 01734 - Indoor Air Quality

D. Section 06410 - Custom Cabinets: Shop fabricated custom cabinet work.

E. Section 09900 - Paints and Coatings: Painting and finishing of finish carpentry items.

1.05 REFERENCES

A. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2006, 8th Ed., Version 2.0.

1.06 SUBMITTALS

A. See Section 01300 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Provide data on fire retardant treatment materials and application instructions.
   2. Provide instructions for attachment hardware, finish hardware, and accessories.

C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, accessories, to a minimum scale of 1-1/2 inch to 1 ft.

D. Certified Lumber:
   1. Submit chain-of custody certificate from one of the certifying organizations listed below, certifying that lumber is harvested from a well managed forest.
      a. Scientific Certification Systems, Inc., Oakland CA.
      b. Smart Wood Certification Program: Rainforest Alliance, New York NY

1.07 QUALITY ASSURANCE

A. Perform work in accordance with AWI Architectural Woodwork Quality Standards Illustrated, Custom grade.

B. Certified Wood: All wood must be certified in accordance with the Forest Stewardship Council's (www.fscus.org) guidelines for wood building components.

1.08 INDOOR AIR QUALITY

A. Do not use wood products containing urea-formaldehyde glues (interior grade plywood and particleboard).

1.09 DELIVERY, STORAGE, AND PROTECTION

A. Protect work from moisture damage.

1.10 PROJECT CONDITIONS

A. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

B. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

PART 2 PRODUCTS

2.01 WOOD-BASED COMPONENTS

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

B. Provide sustainably harvested wood, certified or labeled as specified in Section 01600.

C. Provide wood harvested within a 500 mile radius of the project site.

2.02 LUMBER MATERIALS

A. New Dimensional Lumber - Certified: Certified to be from a well managed forest, by one or more of the independent certification organizations accredited by the Forest Stewardship Council listed above.

B. Dimensional Lumber - Used: Provide documentation certifying products are from salvaged wood sources. Provide grading certificates for structural applications.

C. Softwood Lumber: Southern Yellow Pine species, plain sawn, maximum moisture content of 6 percent; with vertical grain,.

D. Hardwood Lumber: Red Oak species, plain sawn, maximum moisture content of 6 percent; with vertical grain.

2.03 SHEET MATERIALS

A. Softwood Plywood: PS 1 Grade A-B, veneer core, low VOC glue.

B. Hardwood Plywood: Veneer core, low VOC glue.

2.04 ADHESIVE

A. Adhesive: Low VOW, no urea-formaldehyde, Type recommended by laminate manufacturer to suit application.

B. Interior Woodwork and Millwork: Low VOC. FS MMM-A-125C, Type II, water and mold resistant. Use ASTM D 3110, dry-use for laminated and finger-joined members. Certified in accordance with ASTM C 557 and complying with required VOC regulations.
   1. Water-based contact cement
   2. Water based construction adhesive

2.05 FASTENERS

A. Fasteners: Of size and type to suit application; stainless steel finish in concealed locations and stainless steel finish in exposed locations.

B. Concealed Joint Fasteners: Threaded steel.

2.06 ACCESSORIES

A. Lumber for Shimming, Blocking, and curbing: Certified softwood lumber of spruce-pine-fir or southern yellow pine species.

B. Wood Filler: Solvent base, tinted to match surface finish color.

2.07 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

2.08 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. Apply wood filler in exposed nail and screw indentations.

C. On items to receive transparent finishes, use wood filler which matches surrounding surfaces and of types recommended for applied finishes.

D. Finish work in accordance with AWI Architectural Woodwork Quality Standards Illustrated, Section 1500, System TR-2 (Transparent).

E. Back prime woodwork items to be field finished, prior to installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

A. Set and secure materials and components in place, plumb and level.

B. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

3.03 PREPARATION FOR SITE FINISHING

A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.

B. Site Finishing: See Section 09900.

C. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

3.04 ERECTION TOLERANCES

A. Maximum Variation from True Position: 1/16 inch.

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

3.05 WASTE MANAGEMENT

A. Separate wood waste and handle according to Sections 01355 and 01732 and in accordance with the Waste Management Plan

B. Separate the following categories for salvage or reuse on site:
   1. Sheet materials larger than 2 square feet.
   2. Framing members larger than 16".
   3. Multiple offcuts of any size larger than 12".

C. The following categories may be re-used in the manufacture of particleboard or medium density fiberboard (MDF):
   1. Composite wood (for example, plywood, OSB, LVL, I-joist, parallel strand, MDF, particleboard).
   2. Clean dimensional lumber.

D. Set aside damaged wood for acceptable alternative uses, for example use as bracing, blocking, cripples or ties.

E. Do not burn materials.

F. Separate the following categories for disposal and place in designated areas for hazardous materials:
   1. Treated, stained or contaminated wood.

G. Sequence work to minimize use of temporary HVAC to dry out building and control humidity.

END OF SECTION

SECTION 06410

CUSTOM CABINETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Cabinet hardware.

C. Factory finishing.

1.02 RELATED SECTIONS

A. Section 01355 - LEED Requirements.

B. Section 01732 - Waste Management.

C. Section 06100 - Rough Carpentry: Blocking

D. Section 06415 - Countertops.

E. Section 08800 - Glazing: Glass for casework.

F. Section 09900 - Paints and Coatings: Site finishing of cabinet exterior.

1.03 REFERENCES

A. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2006, 8th Ed., Version 2.0.

B. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2003 (ANSI/BHMA A156.9).

C. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; Hardwood Plywood & Veneer Association; 2004 (ANSI/HPVA HP-1).

D. NHLA G-101 - Rules for the Measurement & Inspection of Hardwood & Cypress; National Hardwood Lumber Association; 2003.

E. PS 1 - Construction and Industrial Plywood; National Institute of Standards and Technology (Department of Commerce); 1995.

F. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 2005.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.

C. Product Data: Provide data for hardware accessories.

D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet substrate and finish.

E. Samples: Submit actual sample items of proposed pulls and hinges, demonstrating hardware design, quality, and finish.

F. LEED Report: Submit for wood products made from sustainably harvested wood, salvaged and

reused wood, wood fabricated from recovered timber, rapidly renewable materials, and locally-sourced wood, as specified in Section 01355.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Custom quality, unless other quality is indicated for specific items.

B. Perform cabinet construction in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Custom quality, unless other quality is indicated for specific items.

C. Manufacturer Qualifications: Member in good standing of the Architectural Woodwork Institute (AWI) or the Architectural Woodwork Manufacturers Association of Canada (AWMAC) and familiar with the AWI/AWMAC QSI.

D. Quality Certification: Provide inspection and quality certification of completed custom cabinets in accordance with AWI/AWMAC Quality Certification Program.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Protect units from moisture damage.

1.07 ENVIRONMENTAL REQUIREMENTS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 WOOD-BASED COMPONENTS

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

B. Provide sustainably harvested wood, certified or labeled as specified in Section 01600.

C. Provide wood harvested within a 500 mile radius of the project site.

2.02 LUMBER MATERIALS

A. Softwood Lumber: NIST PS 20; Graded in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Grade III/Economy; average moisture content of 4-9 percent; species as follows:
   1. Exposed Surfaces: Species Southern Yellow Pine.
   2. Semi-Exposed Surfaces: Species Southern Yellow Pine.
   3. Concealed Surfaces: Species Southern Yellow Pine.

B. Hardwood Lumber: NHLA; Graded in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Grade III/Economy; average moisture content of 4-9 percent; species as follows:
   1. Exposed Surfaces: Species Plain Sliced Red Oak.
   2. Semi-Exposed Surfaces: Species Plain Sliced Red Oak.
   3. Concealed Surfaces: Species Red Oak.

2.03 PANEL MATERIALS

A. Softwood Faced Plywood:
   1. Exposed Surfaces: NIST PS 1; APA A-A Grade, plain-sliced redwood face veneer, Interior rated adhesives, core of agricultural fiber board or FSC certified particle board, thickness as indicated.
   2. Semi-Exposed Surfaces: NIST PS 1; APA A-B Grade, rotary cut redwood face veneer, Interior rated adhesives, core of agricultural fiber board or FSC certified particle board, thickness as indicated.

3. Concealed Surfaces: NIST PS 1; APA B-B Grade, rotary cut Douglas fir face veneer, Interior rated adhesives, core of agricultural fiber board or FSC certified particle board, thickness as required.

B. Hardwood Faced Plywood: HPVA HP-1; graded in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, core of veneer; type of glue recommended for specific application; thickness as required; face veneer as follows:

2.04 HARDWARE

A. Hardware: BHMA A156.9, types as indicated for quality grade specified.

B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards, multiple holes for pin supports and coordinated self rests, satin chrome finish, for nominal 1 inch spacing adjustments.

C. Drawer and Door Pulls: "U" shaped wire pull, steel with satin finish, 4 inch centers.

D. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with satin finish.

E. Catches: Magnetic.

F. Drawer Slides:
1. Type: Full extension.
2. Static Load Capacity: Commercial grade.
3. Mounting: Side mounted.
4. Stops: Integral type.
5. Features: Provide self closing/stay closed type.

G. Hinges: Full surface (decorative) self-closing type, steel with satin finish.

H. Sliding Door Track Assemblies: Upper and lower track of satin anodized aluminum, with matching shoe equipped with nylon rollers.

2.05 FABRICATION

A. Cabinet Style: Flush overlay.

B. Cabinet Doors and Drawer Fronts: Flush style.

C. Drawer Construction Technique: Dovetail joints.

D. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

E. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

F. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

2.06 FACTORY FINISHING

A. Sand work smooth and set exposed nails and screws.

B. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.

C. Finish work in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Section 1500, Precatalyzed Lacquer, Transparent.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

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

B. Use fixture attachments in concealed locations for wall mounted components.

C. Use concealed joint fasteners to align and secure adjoining cabinet units.

D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

E. Secure cabinets to floor using appropriate angles and anchorages.

F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

G. Site glaze glass materials using the Interior Dry method specified in Section 08800.

3.03 ADJUSTING

A. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

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

END OF SECTION

SECTION 06415

COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinetwork.

1.02 RELATED SECTIONS

A. Section 01355 - LEED Requirements.

B. Section 01732 - Waste Management.

C. Section 06410 - Custom Cabinets.

D. Section 15410 - Plumbing Fixtures: Sinks.

1.03 REFERENCES

A. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005.

B. ISSFA-2 - Classification and Standards for Solid Surfacing Material; International Solid Surface Fabricators Association; 2001 (2002)

C. PS 1 - Construction and Industrial Plywood; 1995.

1.04 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. Specimen warranty.

C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.

D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.

F. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

G. LEED Report: Submit for recycled content and VOC requirements, as specified in Section 01355.

H. Installation Instructions: Manufacturer's installation instructions and recommendations.

I. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Same fabricator as for cabinets on which tops are to be installed.

B. Installer Qualifications: Fabricator.

1.06 DELIVERY, STORAGE, AND HANDLING

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

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 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.

PART 2 PRODUCTS

2.01 COUNTERTOP ASSEMBLIES

A. Solid Surfacing Countertops: Recycled paper base phenolic countertop over continuous substrate.
   1. Flat Sheet Thickness: 1/2 inch, minimum.
   2. Solid Surfacing Sheet: Complying with ISSFA-2 and NEMA LD 3; phenolic resin with recycled paper, unfilled, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Surface Burning Characteristics: Flame spread 25, maximum; smoke developed 450, maximum; when tested in accordance with ASTM E 84.
      b. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
      c. Color and Pattern: To be selected from manufacturer's full line.
      d. Manufacturers:
         1) Kliptech Composites: PaperStone Certified: www.kliptech.com.
         2) ShetkaStone ShetkaStone: www.shetkastone.com.
         3) Richite Company Richlite: www.richlite.com.
         4) Substitutions: See Section 01600 - Product Requirements.
   3. Other Components Thickness: 1/2 inch, minimum.
   4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge.
   5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

2.02 ACCESSORY MATERIALS

A. Wood-Based Components:
   1. Wood fabricated from old growth timber is not permitted.
   2. Provide sustainably harvested wood, certified or labeled as specified in Section 01600.
   3. Provide wood harvested within a 500 mile radius of the project site.

B. Plywood for Supporting Substrate: PS 1 Exterior Type, AC veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.

C. Wheatboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf minimum density; minimum 3/4 inch thick; join lengths using metal splines.

D. Adhesives: Low Voc, chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

2.03 FABRICATION

A. Fabricate in accordance with standards governing fabrication quality that are specified in Section 06410.

B. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.

3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

C. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches, unless otherwise indicated.

D. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.01 EXAMINATION

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

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

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Seal joint between back/end splashes and vertical surfaces.

3.04 CLEANING AND PROTECTION

A. Clean countertops surfaces thoroughly.

B. Protect installed products until completion of project.

C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 07212

BOARD AND BATT INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Rigid insulation board at perimeter foundation wall, exterior wall behind <> wall finish, and exterior wall.

B. Batt insulation and vapor retarder at exterior walls. Batt insulation at typical roof and ceiling .

C. Sheet Vapor Retarder.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 04810 - Unit Masonry Assemblies:

D. Section 06100 - Rough Carpentry: Supporting construction for batt insulation.

E. Section 07840 - Firestopping.

1.04 REFERENCES

A. ASTM C 578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2004a.

B. ASTM C 665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2001.

C. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005.

D. ASTM E 136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2004.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

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

E. LEED Report: Submit for recycled content and air quality requirements, as specified in Section 01355.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.07 INDOOR AIR QUALITY

A. Insulation products that contain loose fiber or chemicals that offgas should be sealed within wall, floor or ceiling cavities.

B. Protect ducts and HVAC system from loose insulation particulates - fiberglass, cellulose, vermiculite, etc.

1.08 SEQUENCING

A. Sequence work to ensure fireproofing and firestop materials are in place before beginning work of this section.

PART 2 PRODUCTS

2.01 BOARD INSULATION MATERIALS

A. Extruded Polystyrene Board Insulation: ASTM C 578, Type IV; Extruded polystyrene board with cut cell surfaces; with the following characteristics:
   1. Recycled Content: Minimum 5 percent.
   2. Board Size: Size suited to each application. Minimum 16x96 inch.
   3. Board Thickness: 2-4 inches and as shown on the drawings.
   4. Board Edges: Square.
   5. Compressive Resistance: 15 psi for above grade and 60 psi for below grade use.
   6. Manufacturers:
      a. Dow Chemical Co: www.dow.com.
      b. Owens Corning Corp: www.owenscorning.com.
      c. Tenneco Building Products: www.tennecobuildingprod.com.
   7. Substitutions: See Section 01600 - Product Requirements.

2.02 BATT INSULATION MATERIALS

A. Batt Insulation: ASTM C 665; preformed glass fiber batt; friction fit, conforming to the following:
   1. Combustibility: Non-combustible when tested in accordance with ASTM E 136, except for facing, if any.
   2. Thermal Resistance:
      a. R-13: 3-1/2" - 4"
      b. R-19: 5-1/2" - 7-1/2"
      c. R-38: 12"
   3. Unfaced fiberglass blankets/batts shall be Type I (ASTM C665) passing ASTM E136 combustion test requirements.
   4. Recycled Content: Minimum 25 percent.
   5. Manufacturers:
      a. CertainTeed Corporation: www.certainteed.com.
      b. Johns Manville Corporation: www.jm.com.
      c. Owens Corning Corp: www.owenscorning.com.
   6. Substitutions: See Section 01600 - Product Requirements.

2.03 ACCESSORIES

A. Sheet Vapor Retarder: Clear polyethylene film for above grade application, 6 mil thick, with a perm rating of 1 or better.

B. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.

C. Insulation Supports:
   1. Corrugated cardboard for overhead installations: 100 percent recycled content.

D. Adhesive: Type recommended by insulation manufacturer for application.
   1. Certify Low VOC emission.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Adhere a 6 inch wide strip of polyethylene sheet over construction, control, and expansion joints with double beads of adhesive each side of joint.

B. Install 2" thick x 24" wide extruded polystyrene boards horizontally at foundation perimeter as shown on the drawings.
   1. Butt edges and ends tightly to adjacent boards and to protrusions.

C. Extend boards over expansion joints, unbonded to foundation on one side of joint.

D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION AT EXTERIOR WALLS

A. Adhere a 6 inch wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints between sheets.
   2. Extend sheet full height of joint.

B. Apply adhesive to back of boards:
   1. Three continuous beads per board length.

C. Install boards horizontally on walls.

D. Extend boards over expansion joints, unbonded to wall on one side of joint.

E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.04 BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over member face.

F. Tape seal tears or cuts in vapor retarder.

G. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.

3.05 PROTECTION OF FINISHED WORK

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

3.06 WASTE MANAGEMENT

A. Plan and coordinate the insulation work to minimize the generation of offcuts and waste. Reuse

insulation scraps to the maximum extent feasible.

B. Separate and recycle waste materials in accordance with the Waste Management Plan and to the maximum extent economically feasible.

C. Preference is to be given to suppliers who take back waste for reuse or recycling.

END OF SECTION

SECTION 07214

FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Soy-base foamed-in-place insulation in masonry cavity walls.

B. Soy-base foamed-in-place insulation at junctions of dissimilar wall and roof materials to achieve a thermal and air seal, with protective overcoat.

1.02 REFERENCES

A. ASTM C 177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2004.

B. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2002.

1.03 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, insulation properties, and preparation requirements.

C. LEED Report: Submit for rapidly renewable material and VOC requirements.

1.04 REGULATORY REQUIREMENTS

A. Conform to applicable code for flame and smoke limitations.

1.05 PROJECT CONDITIONS

A. Sequence work to ensure timely placement of insulation within construction spaces.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not install insulation when ambient temperature is lower than 70 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Soy-Base Closed Cell Foamed-In-Place Insulation:
   1. BioBased Insulation; Product: BioBased 1702: www.biobased.net.
   2. EMEGA Technologies; Product Soy-Based Spray Foam Insulation: www.emegabuild.com.
   3. ENDURATITE: www.enduratite.com.
   4. Substitutions: See Section 01600 - Product Requirements.

2.02 MATERIALS

A. Soy-Based Closed Cell Foamed-In-Place Insulation: Two component thermal insulation produced by combining a soy-based plastic resin and catalyst foaming agent.
   1. Thermal Value: R-Value of 7 per inch @75 deg F mean; ASTM C-518.
   2. Surface Burning Characteristics: Maximum flame spread/Smoke developed of 25/400.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify work within construction spaces or crevices is complete prior to insulation application.

B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat

adhesion.

3.02 PREPARATION

A. Mask and protect adjacent surfaces from over spray or dusting.

B. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION

A. Apply insulation in accordance with manufacturer's instructions.

B. Apply insulation by spray method, to a uniform monolithic density without voids.

C. Apply to fill void in masonry construction and masonry cores.

3.04 PROTECTION OF FINISHED WORK

A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION

SECTION 07240

EXTERIOR INSULATION AND FINISH SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Composite wall cladding of rigid insulation and reinforced finish coating over cementitious base coat ("Class PM").

B. Drainage and water-resistive barriers behind insulation board.

C. Incidental uses of same finish coating applied directly to masonry and gypsum soffit.

1.02 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Applications of work of this Section to the Waste Management Plan.

C. Section 04810 - Unit Masonry Assembly: Wall substrate construction.

D. Section 06100 - Rough Carpentry: Sheathing on wood framing.

E. Section 07620 - Sheet Metal Flashing and Trim: Perimeter flashings.

F. Section 07900 - Joint Sealers: Perimeter and penetration sealants.

1.03 REFERENCES

A. ASTM C 578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2004a.

B. ASTM C 1397 - Standard Practice for Application of Class PB Exterior Insulation and Finish Systems; 2004.

C. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005.

D. EIMA 101.01 - Standard Test Method for Freeze/Thaw Resistance of Exterior Insulation and Finish Systems (EIFS), Class PB; 1995, Revised August 1995 (modified ASTM C 67).

E. EIMA 101.86 - Standard Test Method for Resistance of Exterior Insulation and Finish Systems (EIFS), Class PB to the Effects of Rapid Deformation (Impact); 1995, Revised August 1995.

F. EIMA (PM) - Guideline Specification For Exterior Insulation and Finish Systems, Class PM; EIFS Industry Members Association; 1984, Revised 1999.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate wall and soffit joint patterns, joint details, and molding profiles.

C. Product Data: Provide data on system materials, product characteristics, performance criteria, and system limitations.

D. Selection Samples: Submit manufacturer's standard range of samples illustrating available coating colors and textures.

E. LEED Report: Submit for recycled contents and locally harvested and manufactured materials and products.

1.05 QUALITY ASSURANCE

A. Maintain copy of specified installation standard and manufacturer's installation instructions at project site at all times during installation.

B. EIFS Manufacturer Qualifications: Provide all EIFS products other than insulation from the same manufacturer with qualifications as follows:
   1. Member in good standing of EIMA (EIFS Industry Members Association).
   2. Manufacturer of EIFS products for not less than 5 years.
   3. Manufacturing facilities ISO 9002 certified.

C. Insulation Manufacturer Qualifications: Approved by manufacturer of EIFS and approved and labeled under third party quality program as required by applicable building code.

D. Installer Qualifications: Company specializing in EIFS work, with not less than 3 years of documented experience, and approved by the EIFS manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to project site in manufacturer's original, unopened containers with labels intact. Inspect materials and notify manufacturer of any discrepancies.

B. Storage: Protect adhesives and finish materials from freezing and temperatures in excess of 90 degrees F.
   1. Protect Portland cement based materials from moisture and humidity. Store under cover off the ground in a dry location.
   2. Protect insulation materials from exposure to sunlight.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not prepare materials or apply EIFS during inclement weather unless areas of installation are protected. Protect installed EIFS areas from inclement weather until dry.

B. Do not install finish or sealants when ambient temperature is below 40 degrees F.

C. Do not leave installed insulation board exposed to sunlight.

1.08 WARRANTY

A. See Section 01780 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's standard material warranty, covering a period of not less than 5 years.

C. Provide separate warranty from installer covering labor for repairs or replacement for a period of not less than 5 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Parex, Inc: www.parex.com.
   2. Degussa Wall Systems, Inc: www.senergy.cc.
   3. Sto Corp: www.stocorp.com.
   4. Substitutions: See Section 01600 - Product Requirements.

2.02 EXTERIOR INSULATION AND FINISH SYSTEM

A. Exterior Insulation and Finish System: Reinforced finish coating on mechanically-fastened insulation board over sheet-type drainage layer or spacers and separate sheet-type water-resistive barrier over substrate; provide a complete system that has been tested to show compliance with the following characteristics; include all components of specified system and substrate(s) in tested samples.

B. Fire Characteristics:
   1. Flammability: Pass, when tested in accordance with NFPA 285.
   2. Ignitibility: No sustained flaming when tested in accordance with NFPA 268.
   3. Potential Heat of Foam Plastic Insulation Tested Independently of Assembly: No portion of the assembly having potential heat that exceeds that of the insulation sample tested for flammability (above), when tested in accordance with NFPA 259 with results expressed in Btu per square foot.

C. Water Penetration Resistance: No water penetration beyond the plane of the base coat/insulation board interface after 15 minutes, when tested in accordance with ASTM E 331 at 6.24 psf differential pressure with tracer dye in the water spray; include in tested sample at least two vertical joints and one horizontal joint of same type to be used in construction; disassemble sample if necessary to determine extent of water penetration.

D. Drainage Efficiency: Average minimum efficiency of 90 percent, when tested in accordance with ASTM E 2273 for 75 minutes.

E. Salt Spray Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 300 hours exposure in accordance with ASTM B 117, using at least three samples matching intended assembly, at least 4 by 6 inches in size.

F. Freeze-Thaw Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 60 cycles, when tested in accordance with EIMA 101.01.

G. Weathering Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 2000 hours of accelerated weathering conducted in accordance with ASTM G 153 Cycle 1 or ASTM G 155 Cycle 1, 5, or 9.

H. Water Degradation Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 14 days exposure, when tested in accordance with ASTM D 2247.

I. Mildew Resistance: No growth supported on finish coating during 28 day exposure period, when tested in accordance with ASTM D 3273.

J. Abrasion Resistance Of Finish: No cracking, checking or loss of film integrity when tested in accordance with ASTM D 968 with 500 liters of sand.

2.03 MATERIALS

A. Finish Coating Top Coat: Water-based, air curing, acrylic or polymer-based finish with integral color and texture.
   1. Texture: Medium.
   2. Color: As selected from manufacturer's range of standard colors.

B. Base Coat: Acrylic- or polymer-modified, fiber reinforced Portland cement coating.
   1. Portland Cement: ASTM C 150, Type I or II.
   2. Base Coat Thickness: 1/4 inch, minimum.

C. Reinforcing Mesh: Balanced, open weave glass fiber fabric, treated for compatibility and improved bond with coating, weight, strength, and number of layers as required to meet required system impact rating.

D. Insulation Board: Extruded polystyrene board with natural skin surfaces; ASTM C 578, Type IV; with the following characteristics:
   1. Board Size: 48 x 96 inch.
   2. Board Size Tolerance: 1/16 inch from square and dimension.

3. Board Thickness: As indicated on drawings.
4. Thickness Tolerance: 1/32 inch maximum.
5. Board Edges: Square.
6. Thermal Conductivity (k factor) at 25 degrees F: 0.18 as determined by ASTM C 177.
7. Compressive Resistance: 25 psi.
8. Board Density: 1.6 lb/cu ft.
9. Water Absorption, maximum: 0.3 percent, volume.
10. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/400, when tested in accordance with ASTM E 84.
11. Manufacturers:
    a. Dow Chemical.
    b. Owens Corning Corp..
    c. Tenneco Building Products.
12. Substitutions: See Section 01600 - Product Requirements.

E. Drainage Layer or Spacers: Furnished or approved by EIFS manufacturer; capable of achieving specified drainage rate; not required to be water-resistive, air retarder, or vapor retarder.

F. Water-Resistive Barrier: Sheet type material that constitutes an air retarder but which is vapor permeable; one of the following unless otherwise required by EIFS manufacturer or authorities having jurisdiction:
1. Asphalt Felt: No.15, complying with ASTM D 226 Type I.
2. Air Retarder: Air- and water-resistive sheet complying with ASTM E 1677 Type I, with MINIMUM vapor permeance of 20 perms; furnished or approved by EIFS manufacturer.

2.04 ACCESSORY MATERIALS

A. Insulation Adhesive: Type recommended by EIFS manufacturer for project substrate.

B. Insulation Fasteners: Fastener and plate system appropriate for substrate and as recommended by EIFS manufacturer.

C. Metal Flashings: As specified in Section 07620.

D. Flashing Tape: Self-adhering rubberized asphalt tape with polyethylene backing for maintenance of continuous weather barrier at substrate transitions and intersections with other materials.

E. Metal Lath: ASTM C 847, self-furring galvanized diamond mesh, 2.5 lb/sq yd.

F. Trim: EIFS manufacturer's standard PVC or galvanized steel trim accessories, as required for a complete project and including starter track.

G. Sealant Materials: As recommended by EIFS manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Install in accordance with EIFS manufacturer's instructions and ASTM C 1397.

B. Where different requirements appear in either document, comply with the most stringent.

C. Neither of these documents supercedes the provisions of the Contract Documents that define the contractual relationships between the parties or the scope of work.

3.02 EXAMINATION

A. Verify that substrate is sound and free of oil, loose materials, or protrusions that could interfere with EIFS installation and is of a type and construction that is acceptable to EIFS manufacturer. Do not begin work until substrate and adjacent materials are complete and thoroughly dry.

B. Verify that substrate surface is flat, with no deviation greater than 1/4 in when tested with a 10 ft straightedge.

3.03 PREPARATION

A. Install self-furring metal lath over solid substrates that are deemed unacceptable to receive adhesively applied insulation. Install in accordance with ASTM C 1063, except for butt-lapping instead of overlapping..
   1. Attach to concrete masonry using corrosion-resistant power or powder actuated fasteners, or hardened concrete stub nails not less than 3/4 inch long and with heads not less than 3/8 inch wide. Ensure that fasteners are securely attached to substrate and spaced at maximum 16 inches on center horizontally and 7 inches vertically.

B. Apply primer to substrate as recommended by EIFS manufacturer for project conditions.

3.04 INSTALLATION - WATER-RESISTIVE BARRIER

A. Mechanically attach sheet materials to substrate using fasteners and fastener spacing recommended by EIFS manufacturer.

B. Seal all substrate transitions and intersections with other materials with flashing tape, to form continuous water-resistive barrier on exterior of sheathing.

C. At door and window openings, apply flashing tape to seal water-resistive barrier to rough opening structure before installation of metal flashings, sills, or frames.

D. Lap flashing tape at least 2 inches on each side of joint or transition.

E. Install drainage layer or spacers after flashing tape has been completed.

3.05 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's instructions and requirements and recommendations of ASTM C 1397.

B. Accessories: Install starter track, back-wrap mesh or edge-wrap mesh at system terminations and other accessories as recommended by EIFS manufacturer, assuring that track is level and securely fastened.

3.06 INSTALLATION - INSULATION

A. Install in accordance with manufacturer's instructions.

B. Install back wrap reinforcing mesh at all openings and terminations that are not to be protected with trim.

C. On wall surfaces, install boards horizontally.

D. Place boards in a method to maximize tight joints. Stagger vertical joints and interlock at corners. Butt edges and ends tight to adjacent board and to protrusions. Achieve a continuous flush insulation surface, with no gaps in excess of 1/16 inch.

E. Rasp irregularities off surface of installed insulation board.

F. Mechanical Fastening: Space fasteners as recommended by EIFS manufacturer.

3.07 INSTALLATION - FINISH

A. Base Coat: Apply in thickness as necessary to fully embed reinforcing mesh, wrinkle free, including back-wrap at all terminations of the EIFS. Install reinforcing fabric as recommended by EIFS manufacturer.
   1. Lap reinforcing mesh edges and ends a minimum of 2-1/2 inches.
   2. Allow base coat to dry a minimum of 24 hours before next coating application.

B. Install trim as indicated. Install only in full lengths, to minimize moisture intrusion; cut horizontal trim tight to vertical trim.

C. Apply finish coat after base coat has dried not less than 24 hours, embed finish aggregate, and finish to a uniform texture and color.

D. Finish Coat Thickness: As recommended by manufacturer.

E. Apply sealant at finish perimeter and expansion joints in accordance with Section 07900.

3.08 CLEANING AND PROTECTION

A. Do not permit finish surface to become soiled or damaged.

B. Remove excess and waste EIFS materials from project site.

C. Clean EIFS surfaces and work areas of foreign materials resulting from EIFS operations.

END OF SECTION

SECTION 07530

ELASTOMERIC MEMBRANE ROOFING WITH APPLIED STANDING SEAM PROFILE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Elastomeric roofing membrane, adhered conventional application.

B. Vapor retarder.

C. Membrane and metal flashing, including regret and other accessories.

D. Roofing cant strips, stack boots, and roofing expansion joints.

E. Heat air welded standing seam decor profile.

F. Snow Guard.

1.02 RELATED SECTIONS

A. Section 06100 - Rough Carpentry: Wood nailers and curbs.

1.03 REFERENCES

A. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension; 1998a (Reapproved 2002).

B. ASTM D 624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers; 2000.

C. FM DS 1-28 - Design Wind Loads; Factory Mutual Research Corporation; 2005.

D. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association; Fifth Edition, with interim updates.

E. UL (RMSD) - Roofing Materials and Systems Directory; Underwriters Laboratories Inc.; current edition.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.

C. Shop Drawings: Indicate joint or termination detail conditions and conditions of interface with other materials.

D. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.

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

F. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.

G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.

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

C. Applicator Qualifications: Company specializing in performing the work of this section approved by manufacturer.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.

B. Store products in weather protected environment, clear of ground and moisture.

1.07 PROJECT CONDITIONS

A. Coordinate the work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not apply roofing membrane during unsuitable weather.

B. Do not apply roofing membrane when ambient temperature is below 40 degrees F.

C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

1.09 WARRANTY

A. See Section 01780 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a two year period after Date of Substantial Completion.

C. Provide Twenty year manufacturer's material and labor warranty to cover failure to prevent penetration of water.

D. The Contractor shall provide the following:
   1. Manufacturer's 20-year No Dollar Limit, "Total System" warranty with flashing endorsement; warranty shall cover materials and labor including insulation. The warranty shall include provisions requiring inspection of the roof by the manufacturer every two (2) years, during the warranty period, to assure the roof system remains waterproof and in warranty condition.
   2. Provide ten year manufacturer's material and labor warranty on fluid-applied surfacing to cover loss in reflectivity due to material failure, cracking and peeling
   3. Roofing Contractor's 5-year material and labor warranty. The contractor's warranty shall neither replace nor negate any agreement furnished by the manufacturer.

E. The warranties shall state that the Owner has the right, at any time during the Contractor's warranty period to make emergency repairs to protect the contents of the building or the building itself from damage due to leaking. The cost of emergency repairs made during the warranty period shall be borne by the Contractor and action by the Owner shall not invalidate the warranty.

F. With regard to repair of roofing leaks under the terms of the manufacturer's warranty, the manufacturer shall replace insulation which has been damaged by leakage when that insulation contains detrimental amounts of moisture.

G. In addition, should the roof system experience recurring leaks (more than two (2) in a given section of the roof system) over a period of 12 consecutive months, the Owner may request an inspection of that portion of the roofing system experiencing recurring leaks by the manufacturer or its designated representative. The manufacturer shall then follow the recommendations of the

inspector as to appropriate resolution of the problem.

H. The effective date of all warranties shall be the same and shall be on the date of the last final inspection when the Owner, Designer, Contractor and Manufacturer agree that all work has been completed in substantial compliance with the plans and specifications.

PART 2 PRODUCTS

2.01 ROOFING - UNBALLASTED APPLICATIONS

A. Elastomeric Membrane Roofing: One ply membrane, fully adhered.

B. Roofing Assembly Requirements:
   1. Roof Covering External Fire-Resistance Classification: UL Class A.
   2. Factory Mutual Classification: Class I and windstorm resistance of I-90, in accordance with FM DS 1-28.

C. Surfacing: Colored roof coating.

D. Color: EnergyStar. Color to be selected by Architect out of manufacturer's standard color range.

2.02 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Membrane: Polyvinyl chloride (PVC); internally reinforced with fibers; complying with ASTM D 4434, Type II, Grade 1.
   1. Thickness: 0.048 inch.
   2. Sheet Width: 78.75 inch.
   3. Color: To be selected by Architect in manufacturer's standard color range
   4. Tensile Strength: 1600 psi, measured in accordance with ASTM D 638.
   5. Ultimate Elongation: 250 percent, measured in accordance with ASTM D638.
   6. Tear Resistance: 14 lbf, measured in accordance with ASTM D 1004.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Colored Finish Coating: Neoprene/hypalon, with aluminum powder concentrate; finish coat of color as selected.

D. Vapor Retarder: Reinforced Kraft paper laminate complying with requirements of fire rating classification; compatible with roofing and insulation materials.
   1. Fire-retardant adhesive.

E. Flexible Flashing Material: Same material as membrane.

F. Separation Sheet: Sheet polyethylene; 2 mil thick.

G. Water Pervious Fabric: Woven polyethylene, UV stabilized, open to moisture movement, white.

2.03 ACCESSORIES

A. Prefabricated Roofing Expansion Joint Flashing: Sheet butyl over closed-cell foam backing seamed to galvanized steel flanges.

B. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.

C. Prefabricated Cant and Edge Strips: Perlite board, compatible with roofing materials; cants formed to 45 degree angle.

D. Membrane Adhesive: As recommended by membrane manufacturer.

E. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

F. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with

membrane.

G. Roofing Nails: Galvanized, hot dipped type, size and configuration as required to suit application.

H. Strip Reglet Devices: Galvanized steel, maximum possible lengths per location, with attachment flanges.

I. Sealants: As recommended by membrane manufacturer.

J. Snow Guard: Aluminum bar type, installed at location shown on drawing, as recommended by membrane manufacturer.

K. Standing Seam Decor Profile: Standing seam decor profile heat air welded to membrane at 24" O.C. on rectangular roof and 48" O.C. at the roof edge on radial roof.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 WOOD DECK PREPARATION

A. Verify flatness and tightness of joints of wood decking. Fill knot holes with latex filler.

B. Confirm dry deck by moisture meter with 12 percent moisture maximum.

3.03 MEMBRANE APPLICATION

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

B. Shingle joints on sloped substrate in direction of drainage.

C. Fully Adhered Application: Apply adhesive to substrate at rate of manufacturer's installation manual. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.

D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.

E. At intersections with vertical surfaces:
   1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
   2. Fully adhere flexible flashing over membrane and up to nailing strips.
   3. Secure flashing to nailing strips at 4 inches on center.
   4. Insert flashing into reglets and secure.

F. Around roof penetrations, seal flanges and flashings with flexible flashing.

G. Install roofing expansion joints where indicated. Make joints watertight.
   1. Install prefabricated joint components in accordance with manufacturer's instructions.

H. Coordinate installation of roof drains and sumps and related flashings.

I. Install snow guard as recommended by membrane manufacturer.

J. Heat air weld standing seam decor profile at 16" O.C. as recommemded by membrane manufacturer.

3.04 FIELD QUALITY CONTROL

A. Require site attendance of roofing material manufacturers daily during installation of the Work.

3.05 CLEANING

A. Remove bituminous markings from finished surfaces.

B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

3.06 PROTECTION OF FINISHED WORK

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

SECTION 07620

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, and downspouts.

B. Extent of each type of flashing and sheet metal work is indicated on the drawings and by provisions of this section.

C. Types of work specified in this section include, but not limited to the following:
   1. Metal wall flashing.
   2. Preformed, prefinished metal coping and flashing.
   3. Miscellaneous sheet metal accessories.
   4. Laminated and composition flashing.
   5. Expansion joint flashing.
   6. Scuppers.
   7. Reglets and accessories.
   8. Gutters and downspout.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 04810 - Unit Masonry Assemblies: Execution requirements for recessed flashing reglets and accessories.

D. Section 04810 - Unit Masonry Assemblies: Through-wall flashings in masonry.

E. Section 07530 - Elastomeric Membrane Roofing: Gutters & Downspouts.

F. Section 07900 - Joint Sealers.

G. Section 09900 - Paints and Coatings: Field painting.

1.04 REFERENCES

A. ASTM A 792/A 792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 1999.

B. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2003.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate all material profiles, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details. Include details proposed to seam and install coping and provide for expansion.

C. Samples: Submit two samples 4x6 inch in size of each type illustrating materials and finish color.

D. LEED Report: Submit for recycled contents and locally harvested and manufactured materials and products.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details, except as otherwise indicated.

B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with ten years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials which may cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Pre-formed, Pre-finished Metal Coping, Scuppers, and Other Exposed Metal Flashing:
   1. Metal coil material, aluminum-zinc alloy-coated, conforming to ASTM A 792/A 792M, Structural Steel (SS), Grade 33 (230), Coating Designation AZ55/AZM165, 24 gage (0.6 mm) minimum sheet thickness, typical, or as otherwise specified.
   2. Finish:
      a. Interior face: Factory-applied corrosion-resistant wash coat, 0.25 mil dry film thickness (DFT).
      b. Exterior face: Factory-applied fluorocarbon paint coating containing minimum 70% KYNAR(R) resins by volume, 1.25 mil dry film thickness (DFT), color selected from manufacturer's standard colors as selected by Architect.
      c. Finish shall be embossed and shall conform to all tests for adhesion, flexibility, fading, chalking, peel resistance and longevity in accordance with ASTM D 2244-79 (chalk rating of 8 or less) and ASTM D 659-80 (5 NBS units or less).

B. Thru Wall Flashing, Head, Jamb and Sill Flashing, and Other Unexposed Flashing: Self-Adhering Rubberized Asphalt Flashing Material: 40 mil sheet consisting of 8 mil high density cross-laminated polyethylene film bonded to 32 mil highly adhesive rubberized asphalt. Provide one of following products:
   1. Advanced Building Products, Inc.; PEEL-N-SEAL.
   2. Fiberweb; Aqua Flash 500.
   3. Hohmann & Barnard, Inc.; TeXtroflash.
   4. Substitution: See Section 01600 - Product Requirements.

2.02 ACCESSORIES

A. Provide sheet metal clips, straps, anchoring devices and similar items as required for installation of work, matching or compatible with material being installed, noncorrosive, and in size and gage required for performance.

B. Fasteners: Shall be of same metal as flashing/sheet metal, or of other non-corrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.

C. Cleats: Formed from same metal as precoated sheet steel, 22 gauge.

D. Sealants: As specified in Division 7.
   1. Use noncuring type for concealed joints
   2. Use nonsag elastomeric type for exposed joints

E. Adhesives: Two-component noncorrosive epoxy adhesive as recommended by flashing sheet manufacturer for waterproof/weather-resistant sealing and adhesive application of flashing sheet.

F. Slip Sheet: Rosin sized building paper.

G. Reglets: Recessed type, galvanized steel; face and ends covered with plastic tape.

2.03 FABRICATION

A. General Metal Fabrication: Shop-fabricate work to greatest extent possible. Comply with details shown, and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather-resistant performance and with expansion provisions for running work, sufficient to permanently prevent leakage, damage, or deterioration of the work. Form work to fit substrates. Comply with material manufacturer instructions and recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling and tool marks, true to line and levels indicated, and with exposed edges folded back to form hems. Conceal fasteners and expansion provisions wherever possible. Exposed fasteners are not acceptable on faces of sheet metal exposed to public view.

B. Form sections true to shape, accurate in size, square, and free from distortion or defects.

C. Fabricate cleats of same material as sheet, in 22 ga material, minimum 8 inches wide, interlocking with sheet. Cleats shall be continuous.

D. Form pieces in longest possible lengths.

E. Hem exposed edges on underside 1/2 inch; miter and seam corners.

F. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

G. Expansion Provisions: Where lapped or bayonet-type expansion provisions in work cannot be used, or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1" deep, filled with mastic sealant (concealed within joints).
   1. Provide for thermal expansion of exposed sheet metal work, flashing, and trim, according to material manufacturer's recommendations. Keep joints at least 2 feet from corners or intersections.

H. Sealant Joints: Where movable, non-expansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliance with SMACNA standards.

I. Separations: Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer. Provide for thermal expansion and building expansion.

J. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

K. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.

L. Fabricate flashings to allow toe to extend at least 2 inches over roofing and as shown on the drawings. Return and brake edges.

2.04 GUTTER AND DOWNSPOUT FABRICATION

A. Gutters: Profile as indicated.

B. Downspouts: Rectangular profile.

C. Gutters and Downspouts: Sizes indicated.

D. Accessories: Profiled to suit gutters and downspouts.
   1. Anchorage Devices: In accordance with SMACNA requirements.
   2. Gutter Supports: Brackets. Minimum 22 gauge.
   3. Downspout Supports: Brackets. Minimum 22 gauge. Color to match

E. Splash Pans: Same metal type as downspouts, formed to 8 x 16 inches size; rolled sides of 2 inch high for inverted pan placement.

F. Downspout Boots: PVC.

G. Seal metal joints.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, reglets, and cleats before starting installation of flashings.

B. Where shown in masonry, furnish reglets to trades of masonry work for installation as work for Division 4 sections.

C. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.

D. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION

A. See Section 04810 for reglet installation requirements.

B. General: Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations, and with SMACNA "Architectural Sheet Metal Manual". Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units. Conceal fasteners wherever possible, and set units true to line and level as indicated. Install work with laps, joints and seams which will be permanently watertight and weatherproof.

C. Insert counter-flashings into reglets to form tight fit. Secure in place with lead wedges at 12 inches on center. Pack remaining spaces with lead wool. Seal flashings into reglets with sealant.

D. Secure flashings in place using concealed fasteners wherever possible, and whenever exposed to public view.

E. Apply plastic cement compound between metal flashings and felt flashings.

F. Fit flashings tightly in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

G. Seal metal joints watertight.

H. Parapet Coping: Shall be installed with appropriate inter-locking means and sloped to roof side for positive drainage. Seams shall be minimized.

I. Nail flanges of expansion joint units to curb nailers, at maximum spacing of 6". Fabricate seams at joints between units with minimum 3" overlap, to form a continuous waterproof system.

J. Secure gutters and downspouts in place using concealed fasteners.

K. Connect downspouts to downspout boots. Grout connection watertight.

L. Set splash pans under downspouts on roof. Set in place with sealant bed.

3.04 FIELD QUALITY CONTROL

A. See Section 01400 - Quality Requirements, for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

3.05 WASTE MANAGEMENT

A. Recycle metal scrap in accordance with the Waste Management Plan.

B. Collect metal scrap and place in designated area for recycling.

3.06 CLEANING AND PROTECTION:

A. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes.

B. Protection: Installer shall advise Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction, to ensure that work will be without damage or deterioration, other than natural weathering, at time of substantial completion.

END OF SECTION

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SECTION 07840

FIRESTOPPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Firestopping materials.

B. Firestopping of all penetrations and interruptions to fire rated assemblies, whether indicated on drawings or not, and other openings indicated.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 01700 - Execution Requirements: Cutting and patching.

D. Section 09260 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.04 REFERENCES

A. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.

B. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; www.aqmd.gov.

C. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Schedule of Firestopping: List each type of penetration.

C. Product Data: Provide data on product characteristics.

D. LEED Report: Submit VOC content documentation for all non-preformed materials.

E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

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

G. Certificate from authority having jurisdiction indicating approval of materials used.

1.06 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs which provide the scheduled fire ratings when tested in accordance with methods indicated.
   1. Listing in the current-year classification or certification books of UL or FM will be considered as constituting an acceptable test report.

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

1.07 ENVIRONMENTAL REQUIREMENTS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

C. Provide certification from the Manufacturer that the specified product does not contain any hazardous materials, including asbestos.

PART 2 PRODUCTS

2.01 FIRESTOPPING ASSEMBLIES

A. Firestopping: Any material meeting requirements.
   1. Fire Ratings: See Drawings for required systems and ratings.

2.02 MATERIALS

A. Firestopping Sealants: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.

B. Elastomeric Silicone Firestopping: Single component silicone elastomeric compound and compatible silicone sealant; conforming to the following:
   1. Manufacturers:
      a. Dow Corning Fire Stop Sealant, Dow Corning Corp.
      b. CP 606, Hilti, Inc.
      c. RTV 7403, General Electric Co,
      d. Fyre Putty, Standard Oil Engineered Materials Co.
      e. Substitutions: See Section 01600 - Product Requirements.

C. Foam Firestoppping: Single component foam compound; conforming to the following:
   1. Manufacturers:
      a. 3M Fire Protection Products: www.3m.com/firestop.
      b. Hilti, Inc: www.us.hilti.com.
      c. Specified Technologies, Inc: www.stifirestop.com.
      d. Substitutions: See Section 01600 - Product Requirements.

D. Fibered Compound Firestopping: Formulated compound mixed with incombustible non-asbestos fibers; conforming to the following:
   1. Manufacturers:
      a. A/D Fire Protection Systems Inc: www.adfire.com.
      b. USG: www.usg.com.
      c. Substitutions: See Section 01600 - Product Requirements.

E. Fiber Firestopping: Mineral fiber insulation used in conjunction with elastomeric surface sealer forming airtight bond to opening; conforming to the following:
   1. Manufacturers:
      a. A/D Fire Protection Systems Inc: www.adfire.com.
      b. Pecora Corporation: www.pecora.com.
      c. USG: www.usg.com.
      d. Substitutions: See Section 01600 - Product Requirements.

F. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material.

B. Remove incompatible materials which may affect bond.

C. Install backing materials to arrest liquid material leakage.

3.03 INSTALLATION

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

B. Install labelling required by code.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces of firestopping materials.

B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07900

JOINT SEALERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Sealants and joint backing.

B. Precompressed foam sealers.

1.03 RELATED SECTIONS

A. Section 01732 - Construction Waste Management: Application of work of this Section to the Waste Management Plan.

B. Section 01734 - Indoor Air Quality - Low VOC Requirements

C. Section 02741 - Asphalt Concrete Paving: Sealants required in conjunction with paving.

D. Section 06200 - Finish Carpentry

E. Section 07130 - Sheet Waterproofing: Sealants required in conjunction with waterproofing.

F. Section 07840 - Firestopping: Firestopping sealants.

G. Section 08800 - Glazing: Glazing sealants and accessories.

H. Section 09260 - Gypsum Board Assemblies: Acoustic sealant.

I. Section 09300 - Tile: Sealant used as tile grout.

J. Section 09900 - Paints and Coatings

1.04 REFERENCES

A. ASTM C 834 - Standard Specification for Latex Sealants; 2000.

B. ASTM C 919 - Standard Practice for Use of Sealants in Acoustical Applications; 2002.

C. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants; 2002.

D. ASTM C 1193 - Standard Guide for Use of Joint Sealants; 2005.

E. ASTM D 1667 - Standard Specification for Flexible Cellular Materials--Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam); 1997.

F. BAAQMD 8-51 - Bay Area Air Quality Management District Regulation 8, Rule 51, Adhesive and Sealant Products; www.baaqmd.gov; current edition.

G. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; www.aqmd.gov.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide cut sheets and data indicating sealant chemical characteristics and manufacturer's usage recommendations.

C. Samples: Submit color samples illustrating sealant colors for selection.

D. LEED Report: Submit VOC content documentation for all non-preformed sealants and primers.

E. Manufacturer's Installation Instructions: Indicate special procedures.

1.06 QUALITY ASSURANCE

1.07 ENVIRONMENTAL QUALITY ASSURANCE

A. Do not use products containing methylene chloride or chlorinated hydrocarbons.

B. Avoid products containing bactericides and fungicides that are classified as phenol mercury acetates, phenol phenates, or phenol formaldehyde.

C. Avoid products containing aromatic and aliphatic solvents.

D. Avoid products containing styrene butadiene.

1.08 INDOOR AIR QUALITY

A. The following sealants are considered safe for indoor use:
1. Oleoresinous (small amounts of aliphatic hydrocarbons).
2. Acrylic emulsion latex (water based).
3. Polysulfide (small amounts of toluene vapors).
4. Polyurethane (small amounts of xylene and other solvents).
5. Silicone (small amounts of xylene and other solvents).

B. The use of the following sealants should be avoided indoors:
1. Butyl rubber (aliphatic hydrocarbons).
2. Solvent based acrylic (xylene).
3. Neoprene (xylene).
4. Styrene butadiene rubber (various VOCs - hexane, toluene and xylene depending on type).
5. Nitrile (various VOCs - hexane, toluene and xylene depending on type).

1.09 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.10 COORDINATION

A. Coordinate the work with all sections referencing this section.

1.11 WARRANTY

A. See Section 01780 - Closeout Submittals, for additional warranty requirements.

B. Correct defective work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One-Part Nonacid Curing Silicone Sealants:
1. Bostik, Inc; Product Chem-Calk N Cure 2000: www.bostik-us.com.
2. GE Plastics; Product Silglaze N SCS 2501or Silpruf SCS 2000: www.geplastics.com.
3. Pecora Corporation; Product 864: www.pecora.com.
4. Substitutions: See Section 01600 - Product Requirements.

B. One-Part Acid Curing Silicone Sealants:

1. Bostik; Product Chem-Calk1200: www.bostik.com.
2. GE Plastics; Product SCS 1000 or Construction 1200: www.geplastics.com.
3. Pecora Corporation; Product 863: www.pecora.com.
4. Sonneborn Building Products, ChemRex, Inc; Product Omniplus: www.chemrex.com.
5. Substitutions: See Section 01600 - Product Requirements.

C. One-Part Mildew Resistant Silicone Sealant
1. GE Plastics; Product SCS 1702 Sanitary: www.geplastics.com.
2. Pecora Corporation; Product 863 #345 White: www.pecora.com.
3. Sonneborn Building Products, ChemRex, Inc; Product Omniplus: www.chemrex.com.
4. Substitutions: See Section 01600 - Product Requirements.

D. Multi-Part Pourable Urethane Sealants:
1. Bostik; Product Chem-Calk 550: www.bostik.com.
2. Pecora Corporation; Product NR-200 Urexpan: www.pecora.com.
3. Sonneborn Building Products, ChemRex, Inc; Product Sonolastic Paving Joint Sealant: www.chemrex.com.
4. Substitutions: See Section 01600 - Product Requirements.

E. Polyurethane Sealants:
1. Bostik, Inc: www.bostik-us.com.
2. Pecora Corporation: www.pecora.com.
3. Degussa Building Systems/Sonneborn: www.chemrex.com.
4. Substitutions: See Section 01600 - Product Requirements.

F. Polysulfide Sealants:
1. Pecora Corporation: www.pecora.com.
2. Degussa Building Systems/Sonneborn: www.chemrex.com.
3. Substitutions: See Section 01600 - Product Requirements.

G. Acrylic Emulsion Latex Sealants:
1. Bostik, Inc; Product Chem-Calk 600: www.bostik-us.com.
2. Pecora Corporation; Product AC-20: www.pecora.com.
3. Degussa Building Systems/Sonneborn; Product Sonolac: www.chemrex.com.
4. Substitutions: See Section 01600 - Product Requirements.

H. Preformed Compressible Foam Sealers:
1. Sandell Manufacturing Company, Inc; Product Polyseal: www.sandellmfg.com.
2. Dayton Superior Corporation; Product Polytite Standard or Polytite R: www.daytonsuperior.com.
3. Substitutions: See Section 01600 - Product Requirements.

I. Tamp-in Sealants:
1. Oakum
2. Caulking cord: Fine fiber yarn saturated with wax. Contains linseed oil and talcum.

2.02 SEALANTS

A. Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than required by the more stringent of the South Coast Air Quality Management District Rule No.1168 and the Bay Area Air Quality Management District Regulation 8, Rule 51.

B. Type JS1 - General Purpose Exterior Sealant: Polyurethane; ASTM C 920, Grade NS, Class 25, Uses M, G, and A; single component.
1. Color: Standard colors matching finished surfaces.

C. Type JS2 - One-part Nonacid Curing: Silicone, ASTM C 920 Type S, Grade NS, Class 25, Uses T, NT, M, G, A, and as applicable to joint surfaces, O.

1. Color: Standard colors matching finished surfaces.
2. Applications: Use for:
   a. exterior and interior joints in vertical surfaces of concrete and masonry.
   b. between concrete masonry and stone.
   c. between metal and concrete, mortar, or stone
   d. interior and exterior perimeter joints of metal frames in exterior walls.
   e. exterior overhead joints.

D. Type JS3 - One-part Acid Curing: Silicone, ASTM C 920 Type S, Grade NS, Class 25, Uses NT, G, A, and as applicable to joint surfaces, O.
   1. Color: Standard colors matching finished surfaces.
   2. Applications: Use for:
      a. exposed joints within skylight framing system.

E. Type JS4 - Exterior Expansion Joint Sealer: Precompressed foam sealer; urethane with water-repellent;
   1. Applications: Use for:
      a. Exterior wall expansion joints.

F. Type JS5 - Exterior Metal Lap Joint Sealant: Polyisobutylene, nondrying, nonskinning, noncuring.
   1. Applications: Use for:
      a. Concealed sealant bead in sheet metal work.
      b. Concealed sealant bead in siding overlaps.

G. Type JS6 - General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C 834, Type OP, Grade NF single component, paintable.
   1. Applications: Use for:
      a. Interior wall and ceiling control joints.
      b. Joints between door and window frames and wall surfaces.
      c. interior joints in field painted vertical and overhead surfaces.
      d. in gypsum board, concrete or concrete masonry
      e. Other interior joints for which no other type of sealant is indicated.

H. Type JS5 - Bathtub/Tile Sealant: White silicone; ASTM C 920, Uses I, M and A; single component, mildew resistant.
   1. Applications: Use for:
      a. Joints between plumbing fixtures and floor and wall surfaces.
      b. Joints between kitchen and bath countertops and wall surfaces.
      c. Interior joints in vertical surfaces of ceramic tile in toilet rooms, showers and kitchens.

I. Type JS6 - Acoustical Sealant: Latex sealant; ASTM C 919, Grade NS, Class 12-1/2, Uses M and A; single component, Low VOC, non-skinning, permanently flexible.
   1. Applications: Use for concealed locations only:
      a. Sealant bead between top stud runner and structure and between bottom stud track and floor.

J. Type JS7 - Interior Floor Joint Sealant: Polyurethane, self-leveling; ASTM C 920, Grade P, Class 25, Uses T, M and A; multi- component.
   1. Applications: Use for:
      a. Expansion joints in floors.

K. Type JS8 - Sealant for Continuous Water Immersion: Polysulfide; ASTM C 920, Grade NS, Class 25, Uses I, M, and A; approved by manufacturer for continuous water immersion; single component.

L. Type JS9 - Concrete Paving Joint Sealant: Polyurethane, self-leveling; ASTM C 920, Class 25,

Uses T, I, M and A; multi- component.

1. Applications: Use for:
   a. Joints in sidewalks and vehicular paving.

M. Type JS11 - Acrylic Sealant: ASTM C 920, Grade NS, Class 12-1/2, Uses NT, M, A, O; single component, solvent curing, non-staining, non-bleeding, non-sagging.

N. Type JS12 - Nonsag Polysulfide Sealant: ASTM C 920, Grade NS, Class 25, Uses NT, I, M, A, G, O; two component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging type.

O. Type JS13 - Self-Leveling Polyurethane Sealant: ASTM C 920, Grade P, Class 25, Uses T, M, A; multi- component, chemical curing, non staining, non bleeding, capable of continuous water immersion, self-leveling type.

2.03 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

A. Remove loose materials and foreign matter which might impair adhesion of sealant.

B. Clean and prime joints in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C 1193.

D. Protect elements surrounding the work of this section from damage or disfigurement.

3.03 INSTALLATION

A. Minimize use of sealants, caulks and adhesives through proper detailing, including adequate overhangs and eaves, flashing and proper lapping of building paper and trim.

B. Use oakum to seal around penetrations where feasible and allowable by code.

C. Use dry adhesive sealant tape instead of wet sealants where feasible.

D. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

E. Perform installation in accordance with ASTM C 1193.

F. Perform acoustical sealant application work in accordance with ASTM C 919.

G. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:

1. Width/depth ratio of 2:1.
2. Neck dimension no greater than 1/3 of the joint width.
3. Surface bond area on each side not less than 75 percent of joint width.

H. Install bond breaker where joint backing is not used.

I. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

J. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

K. Tool joints concave.

L. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

M. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal all joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.

3.04 CLEANING

A. Clean adjacent soiled surfaces.

3.05 PROTECTION OF FINISHED WORK

A. Protect sealants until cured.

3.06 WASTE MANAGEMENT

A. Separate waste in accordance with the Waste Management Plan.

B. Close and seal tightly all partly used sealant containers and store protected in well-ventilated fire-safe area at moderate temperature.

C. Place used sealant tubes and containers in areas designated for hazardous materials.

END OF SECTION

SECTION 08110

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Non-fire-rated steel doors and frames.

B. Steel frames for wood doors.

C. Fire-rated steel frames.

D. Thermally insulated steel doors.

E. Steel glazing frames.

F. Accessories, including glazing and matching panels.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan; Recycling of steel.

C. Section 07900 - Joint Sealers

D. Section 08211 - Flush Wood Doors

E. Section 08710 - Door Hardware.

F. Section 08800 - Glazing: Glass for doors and borrowed lites.

G. Section 09900 - Paints and Coatings: Field painting.

1.04 REFERENCES

A. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 2003.

B. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 1998.

C. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2004a.

D. ASTM C 236 - Standard Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box; 1989 (Reapproved 1993).

E. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus; 1997.

F. DHI A115 Series - Specifications for Steel Doors and Frame Preparation for Hardware; Door and Hardware Institute; 2000 (ANSI/DHI A115 Series).

G. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 1999.

H. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association; 1999.

I. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association; 2003.

J. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

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

E. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

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

G. LEED Report: Submit for recycled contents and locally harvested and manufactured products.

1.06 QUALITY ASSURANCE

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

B. Maintain at the project site a copy of all reference standards dealing with installation.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store in accordance with NAAMM HMMA 840.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 PRODUCTS

2.01 DOORS AND FRAMES

A. Requirements for All Doors and Frames:
   1. Accessibility: Comply with ANSI/ICC A117.1.
   2. Door Top Closures: Flush with top of faces and edges.
   3. Door Edge Profile: Beveled on both edges.
   4. Door Texture: Smooth faces.
   5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
   6. Hardware Preparation: In accordance with DHI A115 Series, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
   7. Finish: Factory primed, for field finishing.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.02 STEEL DOORS

A. Exterior Doors:
   1. Grade: ANSI A250.8 Level 3, physical performance Level A, Model 2, seamless.
   2. Core: Polystyrene foam.
   3. Top Closures for Outswinging Doors: Flush with top of faces and edges.
   4. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A 653/A 653M, with A60/ZF180 coating.
   5. Texture: Smooth faces.
   6. Insulating Value: U-value of 0.10, when tested in accordance with ASTM C 1363.
   7. Weatherstripping: Integral, recessed into door edge or frame.

B. Panels: Same construction, performance, and finish as doors.

2.03 STEEL FRAMES

A. General:
   1. Comply with the requirements of grade specified for corresponding door.
      a. ANSI A250.8 Level 3 Doors: 14 gage frames.
      b. Frames for Wood Doors: Comply with frame requirements specified in ANSI A250.8 Level 3, 14 gage
   2. Finish: Factory primed, for field finishing.
   3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
   4. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
   5. Frames Wider than 48 Inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
   6. Frames Installed Back-to-Back: Reinforce with steel channels anchored to floor and overhead structure.

B. Exterior Door Frames: Fully welded.
   1. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A 653/A 653M, with A60/ZF180 coating.
   2. Weatherstripping: Integral, recessed into door edge or frame.

C. Interior Door Frames, Non-Fire-Rated: Fully welded type.

D. Interior Door Frames, Fire-Rated: Fully welded type.
   1. Fire Rating: Same as door, labeled.

E. Frames for Interior Glazing or Borrowed Lights: Construction and face dimensions to match door frames, and as indicated on drawings.

F. Transom Bars: Fixed, of profile same as jamb and head.

2.04 ACCESSORY MATERIALS

A. Glazing: As specified in Section 08800, factory installed.

B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered corners; prepared for countersink style tamper proof screws.

C. Astragals for Double Doors:
   1. Exterior Doors: Steel, Z-shaped.

D. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.

E. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center

mullion of pairs, and 2 on head of pairs without center mullions.

F. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

2.05 FINISH MATERIALS

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

B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

3.02 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.

B. In addition, install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

E. Coordinate installation of hardware.

F. Coordinate installation of glazing.

G. Touch up damaged factory finishes.

3.04 ERECTION TOLERANCES

A. Clearances Between Door and Frame: As specified in ANSI A250.8.

B. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

3.06 SCHEDULES

A. Refer to Door and Hollow Metal Frame Schedules and details shown on the drawings.

END OF SECTION

SECTION 08211

FLUSH WOOD DOORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Flush wood doors; flush configuration; fire rated and non-rated.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section; Certified Wood Requirements.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 08110 - Steel Doors and Frames.

D. Section 08710 - Door Hardware.

E. Section 08800 - Glazing.

1.04 REFERENCES

A. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2006, 8th Ed., Version 2.0.

B. ICC (IBC) - International Building Code; 2006.

C. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.

D. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association; 1999.

E. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements for submittal procedures.

B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

C. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, factory finishing criteria, identify cutouts for glazing.

D. Samples: Submit two samples of door veneer, 12x12 inch in size illustrating wood grain, stain color, and sheen.

E. Certified Lumber:
   1. Submit chain-of custody certificate from one of the certifying organizations listed below, certifying that lumber is harvested from a well managed forest.
      a. Scientific Certification Systems, Inc., Oakland CA.
      b. Smart Wood Certification Program: Rainforest Alliance, New York NY

F. Manufacturer's Installation Instructions: Indicate special installation instructions.

1.06 QUALITY ASSURANCE

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

B. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging. Inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.08 PROJECT CONDITIONS

A. Coordinate the work with door opening construction, door frame and door hardware installation.

1.09 WARRANTY

A. See Section 01780 - Closeout Submittals for additional warranty requirements.

B. Provide warranty for the following term:
   1. Interior Doors: Life of installation.

C. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form signed by Manufacturer, Installer and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup or twist) or that show telegraphing of core construction in face veneers, or do not conform to tolerance limitations of referenced quality standards.Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

D. Warranty shall include reinstallation which may be required due to repair or replacement of defective doors where defect was not apparent prior to hanging.

E. Warranty shall be in effect beginning with date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Eggers Industries; Product : Environmentally Certified Doors: www.eggersindustries.com.
   2. Marshfield DoorSystems, Inc; Product : Environmental Class Doors: www.marshfielddoors.com.
   3. VT Industries; Product : Architectural Certified Wood Doors: www.vtindustries.com.
   4. Substitutions: See Section 01600 - Product Requirements.

2.02 DOORS

A. All Doors: See drawings for locations and additional requirements.
   1. Quality Standard: AWI Architectural Woodwork Quality Standards Illustrated, Section 1300, Custom Grade with hardware veneer face.
   2. Construction: SLC-5 or SLC-7 (Glued block core, 5- or 7-ply). Cores shall be solid particle board or staved lumber core. Doors shall be 1 3/4" x 7"-0" or as noted in schedule.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at all locations.

2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with International Building Code ("positive pressure"); UL or WH (ITS) labeled without any visible seals when door is open.
3. Wood veneer facing with factory transparent finish.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core Doors: Type staved lumber core (SLC) and faces as indicated above.

B. Fire Rated Doors: Mineral core, Type FD, plies and faces as indicated above.

2.04 DOOR FACINGS

A. Wood Veneer Facing for Transparent Finish: Natural birch, veneer grade as specified by quality standard, rotary cut, book veneer match, balance assembly match; unless otherwise indicated.

2.05 ACCESSORIES

A. Glazing Stops: Rolled steel channel shape, mitered corners; prepared for countersink style tamper proof screws.

2.06 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with Stiles and Rails:

C. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.

D. Fit door edge trim to edge of stiles after applying veneer facing.

E. Vertical Exposed Edge of Stiles - Veneer Faces: Of same species as veneer facing.

F. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

G. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

H. Provide edge clearances in accordance with AWI Quality Standards Illustrated Section 1700.

2.07 FACTORY FINISHING - WOOD VENEER DOORS

A. Factory finish doors in accordance with specified quality standard:
   1. Transparent Finish: Transparent catalyzed vinyl, Custom quality, Satin, Medium Rubbed sheen.

B. Seal door top edge with color sealer to match door facing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.
   1. Install fire-rated doors in accordance with NFPA 80 requirements.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

E. Coordinate installation of glazing.

3.03 INSTALLATION TOLERANCES

A. Conform to specified quality standard for fit and clearance tolerances.

B. Conform to specified quality standard for maximum diagonal distortion.

C. Maximum Diagonal Distortion (Warp): 1/8 inch measured with straight edge or taut string, corner to corner, over an imaginary 36 by 84 inches surface area.

D. Maximum Vertical Distortion (Bow): 1/8 inch measured with straight edge or taut string, top to bottom, over an imaginary 36 by 84 inches surface area.

E. Maximum Width Distortion (Cup): 1/8 inch measured with straight edge or taut string, edge to edge, over an imaginary 36 by 84 inches surface area.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

3.05 WASTE MANAGEMENT

A. Separate corrugated cardboard in accordance with the Waste Management Plan and place in designated areas for recycling.

B. Place used sealant containers in areas designated for hazardous materials.

3.06 SCHEDULE

A. See Door Schedules, Elevations, and Details on the drawings.

END OF SECTION

SECTION 08310

ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Access door and frame units, fire-rated and non-fire-rated, in wall, and ceiling locations.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 09900 - Paints and Coatings: Field paint finish.

D. Section Division 15: Plumbing components requiring access.

E. Section Division 15: Mechanical components requiring access.

F. Section 15910 - Duct Accessories: Access doors in ductwork.

G. Section Division 16: Electrical components requiring access.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

C. Shop Drawings: Indicate location and positioning of all access door units.

D. Manufacturer's Installation Instructions: Indicate installation requirements.

E. Project Record Documents: Record actual locations of all access units.

F. LEED Report: Submit for recycled contents and locally harvested and manufactured products.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable code for fire rated access doors.
   1. Provide access doors of fire rating equivalent to the fire rated assembly in which they are to be installed.

B. Provide products listed and labeled by UL as suitable for the purpose specified and indicated.

1.06 PROJECT CONDITIONS

A. Coordinate the work with other work requiring access doors.

PART 2 PRODUCTS

2.01 ACCESS DOOR UNITS - CEILINGS AND CEILINGS

A. Door and Frame Units: Formed steel.
   1. Frames and flanges: 0.058 inch steel.
   2. Door panels: 0.070 inch double sheet with integral non-combustible insulation filler.

3. Sizes:
   a. Ceilings: 24x24 inches or size as required for access.
4. Hardware:
   a. Hinge: 175 degree steel piano hinge with removable pin.
   b. Lock: Screw driver slot for quarter turn cam lock.
5. Prime coat with baked on primer.
6. Finish: One coat baked enamel, color as selected.

2.02 FABRICATION

A. Weld, fill, and grind joints to ensure flush and square unit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings for door and frame are correctly sized and located.

3.02 INSTALLATION

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

B. Install frames plumb and level in openings. Secure rigidly in place.

C. Position units to provide convenient access to the concealed work requiring access.

3.03 WASTE MANAGEMENT

A. Separate corrugated cardboard in accordance with the Waste Management Plan and place in designated areas for recycling.

B. Place used sealant containers in areas designated for hazardous materials.

END OF SECTION

SECTION 08360

OVERHEAD DOORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Overhead sectional doors, manually operated.

B. Operating hardware, supports, and accessories.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 04810 - Unit Masonry Assemblies: Prepared opening in masonry.

D. Section 05500 - Metal Fabrications: Steel channel opening frame.

E. Section 07900 - Joint Sealers: Perimeter sealant and backup materials.

F. Section 08710 - Door Hardware: Lock cylinders.

G. Section 09900 - Paintings and Coatings

1.04 REFERENCES

A. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2004a.

B. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2002.

C. DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors; Door & Access Systems Manufacturers' Association, International; 2003.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.

C. Product Data: Show component construction, anchorage method, and hardware.

D. Samples: Submit two panel finish samples, 12x12 inch in size, illustrating color and finish.

E. Manufacturer's Installation Instructions: Include any special procedures required by project conditions.

F. Operation Data: Include normal operation, troubleshooting, and adjusting.

G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

H. LEED Report: Submit for recycled contents and locally harvested and manufactured materials

and products.

1.06 WARRANTY

A. See Section 01780 - Closeout Submittals for warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Overhead Door Co.; Product 416 Series.

B. Other Acceptable Manufacturers:
   1. Fimbel Door Corp; Product S-1600: www.fimbeldoor.com.
   2. Clopay Building Products Company, Inc; Product C16ST: www.clopaycommercial.com.
   3. Wayne-Dalton Corporation; Product Model 2416: www.waynedalton.com.
   4. Amarr Garage Door Co.; Product Model 1000: www.amarr.com.
   5. Substitutions: See Section 01600 - Product Requirements.

2.02 STEEL DOOR COMPONENTS

A. Steel Doors: Flush steel, insulated; standard lift operating style with track and hardware; complying with DASMA 102, Commercial application.
   1. Performance: Withstand positive and negative wind loads of 20 lb/sq ft without damage or permanent set, when tested in accordance with ASTM E 330, using 10 second duration of maximum load.
   2. Door Nominal Thickness: 2 inches thick.
   3. Exterior Finish: Pre-finished with baked enamel of color as selected.
   4. Interior Finish: Pre-finished with baked enamel of color as selected.
   5. Operation: Chain hoist.

B. Door Panels: Flush steel construction; outer steel sheet of 0.058 inch thick, flat profile; inner steel sheet of 0.058 inch thick, flat profile; core reinforcement of 16 gauge thick sheet steel roll formed to channel shape, rabbeted weather joints at meeting rails; insulated.

2.03 DOOR COMPONENTS

A. Track: Rolled galvanized steel, 0.090 inch thick; 2 inch wide, continuous one piece per side; galvanized steel mounting brackets 1/4 inch thick.

B. Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of galvanized steel; floating hardened steel bearing rollers, located at top and bottom of each panel, each side.

C. Lift Mechanism: Torsion spring on cross head shaft, with braided galvanized steel lifting cables.
   1. For Manual Operation: Requiring maximum exertion of 25 lbs force to open.

D. Sill Weatherstripping: Resilient hollow rubber strip, one piece; fitted to bottom of door panel, full length contact.

E. Jamb Weatherstripping: Roll formed steel section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.

F. Head Weatherstripping: EPDM rubber seal, one piece full length.

G. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.

H. Lock: Inside side mounted, adjustable keeper, spring activated latch bar with feature to retain in locked or retracted position; interior and exterior handle.

I. Lock Cylinders: See Section 08710.

2.04 MATERIALS

A. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A 653/A 653M, with G60/Z180 coating, plain surface.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

3.02 INSTALLATION

A. Install door unit assembly in accordance with manufacturer's instructions.

B. Anchor assembly to wall construction without distortion or stress.

C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.

D. Fit and align door assembly including hardware.

E. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07900.

F. Install perimeter trim and closures.

3.03 ERECTION TOLERANCES

A. Maximum Variation from Plumb: 1/16 inch.

B. Maximum Variation from Level: 1/16 inch.

C. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch from 10 ft straight edge.

D. Maintain dimensional tolerances and alignment with adjacent work.

3.04 ADJUSTING

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

3.05 CLEANING AND PROTECTION

A. Clean doors, frames.

B. Remove temporary labels and visible markings.

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

3.06 WASTE MANAGEMENT

A. Separate corrugated cardboard in accordance with the Waste Management Plan and place in designated areas for recycling.

B. Place used sealant containers in areas designated for hazardous materials.

END OF SECTION

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SECTION 08410

METAL-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Aluminum-framed storefront, with operable sash.

B. Aluminum doors and frames.

C. Weatherstripping.

D. Door hardware.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Construction Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 04810 - Unit Masonry Assemblies: Preparation of adjacent work to receive work of this section.

D. Section 05120 - Structural Steel: Steel attachment members.

E. Section 05500 - Metal Fabrications: Steel attachment devices.

F. Section 07900 - Joint Sealers: Perimeter sealant and back-up materials.

G. Section 08460 - Automatic Entrance Doors.

H. Section 08710 - Door Hardware: Hardware items other than specified in this section.

I. Section 08800 - Glazing: Glass and glazing accessories.

1.04 REFERENCES

A. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2004a.

B. ASTM B 221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2004.

C. ASTM E 283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004.

D. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2002.

E. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000.

1.05 PERFORMANCE REQUIREMENTS

A. Design and size components to withstand the following load requirements without damage or permanent set, when tested in accordance with ASTM E 330, using loads 1.5 times the design

wind loads and 10 second duration of maximum load.

1. Design Wind Loads: Comply with requirements of ASCE 7.
2. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.

B. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.

C. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at a reference differential pressure across assembly of 1.57 psf as measured in accordance with ASTM E 283.

D. Water Leakage: None, when measured in accordance with ASTM E 331 with a test pressure difference of 2.86 lbf/sq ft.

E. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

F. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

1.06 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.

D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, dimensional limitations.

E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

G. LEED Report: Submit for recycled contents and locally harvested and manufactured materials and products.

1.07 QUALITY ASSURANCE

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

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond to aluminum when exposed to sunlight or weather.

1.09 ENVIRONMENTAL REQUIREMENTS

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

1.10 WARRANTY

A. See Section 01780 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Kawneer Company, Inc; Product Trifab VG 451T with Glassvent: www.kawneer.com.
   2. YKK AP; Product YES 45 TU with YES SSG Vent: www.ykkap.com.
   3. EFCO Corp.; Product 403T with WV-410 Vent: www.efcocorp.com.
   4. Substitutions: See Section 01600 - Product Requirements.

2.02 COMPONENTS

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Finish: Class I color anodized.
   2. Color: Dark Green.

B. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
   1. Glazing stops: Flush.
   2. Cross-Section: 2x4 1/2 inch nominal dimension.

C. Doors: Glazed aluminum.
   1. Thickness: 2 inches.
   2. Top Rail: 8 inches wide.
   3. Vertical Stiles: 6 inches wide.
   4. Bottom Rail: 10 inches wide.
   5. Glazing Stops: Square.
   6. Finish: Same as storefront.

D. Operable Sash: Aluminum project-out awning; finished to match storefront; turn handle latch.

2.03 MATERIALS

A. Extruded Aluminum: ASTM B 221 (ASTM B 221M).

B. Fasteners: Stainless steel.

C. Glass: As specified in Section 08800.

D. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

E. Glazing Accessories: As specified in Section 08800.

2.04 FINISHES

A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils thick.
   1. Color to be chosen from Manufacturer's standard finish colors.

2.05 HARDWARE

A. Door Hardware: Storefront manufacturer's standard type to suit application.
   1. Finish on Hand-Contacted Items: Polished stainless steel.
   2. Include for each door weatherstripping, sill sweep strip, threshold, pivots, push handle, pull handle, exit device, narrow stile handle latch, and closer.

2.06 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.

E. Arrange fasteners and attachments to conceal from view.

F. Reinforce components internally for door hardware.

G. Reinforce framing members for imposed loads.

H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
   1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

2.07 ACCESSORIES

A. Prefabricated Sub-Sill:
   1. Prefabricated aluminum sub-sill in the same material as frames.

B. Insect Screen for Operable Sash:
   1. Aluminum wire mesh type supplied by storefront manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Coordinate attachment and seal of perimeter air and vapor barrier materials.

H. Spray foam sealant in accordance with Section 07900 in shim spaces at perimeter of assembly

to maintain continuity of thermal barrier.

I. Install operating sash.

J. Set thresholds in bed of mastic and secure.

K. Install hardware using templates provided.

L. Install glass in accordance with Section 08800, using glazing method required to achieve performance criteria.

M. Install perimeter sealant in accordance with Section 07900.

3.03 ERECTION TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.05 CLEANING AND PROTECTION

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by method acceptable to sealant manufacturer.

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

E. Protect finished work from damage.

END OF SECTION

SECTION 08460

AUTOMATIC ENTRANCE DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Automatic sliding doors, with frames.

B. Actuators and safety devices.

1.02 REFERENCES

A. BHMA A156.10 - American National Standard for Power Operated Pedestrian Doors; Builders Hardware Manufacturers Association; 2005 (ANSI/BHMA A156.10).

B. BHMA A156.19 - American National Standard for Power Assist and Low Energy Power Operated Doors; Builders Hardware Manufacturers Association; 2002 (ANSI/BHMA A156.19).

C. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2003.

D. NFPA 70 - National Electrical Code; National Fire Protection Association; 2005.

E. UL (ECMD) - Electrical Construction Materials Directory; Underwriters Laboratories Inc.; current edition.

F. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Underwriters Laboratories Inc.; 2002.

1.03 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate layout and dimensions; head, jamb, and sill conditions; elevations; components, anchorage, recesses, materials, and finishes, electrical characteristics and connection requirements.
   2. Identify installation tolerances required, assembly conditions, routing of service lines and conduit, and locations of operating components and boxes.

C. Product Data: Provide data on system components, sizes, features, and finishes.

D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and manufacturer's hardware and component templates.

E. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

F. Maintenance Data: Include manufacturer's parts list and maintenance instructions for each type of hardware and operating component.

G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

H. LEED Report: Submit for locally harvested and manufactured materials and products.

1.04 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.05 PROJECT CONDITIONS

1.06 WARRANTY

A. See Section 01780 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty for operating unit.

1.07 MAINTENANCE PRODUCTS

A. Provide wrenches and tools required for maintenance of equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Automatic Entrance Doors:
   1. Horton Automatics: www.hortondoors.com or approved equal.
   2. Other Manufacturers:
      a. Dor-O-Matic.
      b. Besam Entrance Solutions.
   3. Substitutions: See Section 01600 - Product Requirements.

2.02 AUTOMATIC ENTRANCE DOORS

A. Automatic Sliding Door: Bi-parting double leaf track-mounted, electric operation, extruded aluminum glazed door, with frame, and operator concealed overhead, with energy saving device.
   1. Operation: Power open, power close operation.
   2. "Outside" Side Actuator: Motion sensor.
   3. "Inside" Side Actuator: Motion sensor.
   4. Door and Frame Finish: Anodized, as selected by Architect.
   5. Vertical Jambs: 1-3/4" x 4-1/2"
   6. Door stiles: 2-1/8" wide.
   7. Pivots: Top and bottom concealed pivots, extruded aluminum.
   8. Hardware: Breakaway.
   9. Glazing: 5/8" for active leafs and 1" for fixed leafs, low-E insulated double glazing in accordance with Section 08800.
   10. Door Carriers: 2 steel roller wheels, 1-3.4" diameter, per active door leaf for operation over replaceable Derlin track. Single journal with sealed oil-impregnated bearing.

2.03 DOOR OPERATORS

A. Door Operators - General Requirements: Comply with BHMA A156.10, BHMA A156.19, and UL 325, as applicable.
   1. Select equipment to accommodate medium pedestrian traffic and weight of doors.
   2. Provide equipment capable of operating, holding open, and closing doors under positive and negative wind pressures calculated in accordance with applicable code.
   3. Operating Temperature Range: Minus 30 to 131 degree F ambient.
   4. Provide operators that are fully adjustable for opening and closing speeds, checking speeds, and hold-open time.
   5. Sliding Door Operators: Provide for manual open, close, and break-away operation of door leaves in the event of power failure. Maximum Force for Break-Away Function: 37 lbf.
   6. Conform to applicable code for automatic release of control drive unit to permit manual opening of doors.
   7. Finish exposed components to match door and door hardware finish.
   8. Electric Operators: Overhead-concealed, electro-mechanical, microprocessor controlled.

2.04 ACTUATORS

A. Photo-ElectricActuator: Horizontal single ray device, with aluminum housing for light source and relay units.

2.05 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics:
   1. Power: Self-detecting line voltage capable control. 120V through 240V, 50/60 Hz, 3A incoming power with solid-earth ground connection for each door system.

B. Motors: High-efficiency, energy-efficient, DC motor, NEMA MG 1.

C. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

D. Disconnect Switch: Factory mount disconnect switch in control panel.

2.06 ACCESSORIES

A. Weatherstripping: All active door panel weatherstripping shall be concealed, "finned-pile."

B. Thresholds: Threshold shall be aluminum, 1/2" x 4-1/2" running full width of package.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work and dimensions are as indicated on shop drawings.

B. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

B. Provide for thermal expansion and contraction of door and frame units and live and dead loads that may be transmitted to operating equipment.

C. Provide for dimensional distortion of components during operation.

D. Coordinate installation of components with related and adjacent work; level and plumb.

3.03 ADJUSTING

A. Adjust door equipment for correct function and smooth operation.

3.04 CLEANING

A. Remove temporary protection, clean exposed surfaces.

3.05 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation, operating components, adjustment features, and lubrication requirements.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Hardware for wood and hollow steel doors.

B. Hardware for fire-rated doors.

C. Lock cylinders for doors for which hardware is specified in other sections.

D. Thresholds.

1.03 RELATED SECTIONS

A. Section 08110 - Steel Doors and Frames.

B. Section 08211 - Flush Wood Doors.

C. Section 08360 - Overhead Doors: Hardware for same, except cylinders; installation of cylinders.

1.04 REFERENCES

A. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; Door and Hardware Institute; 2001.

B. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; Door and Hardware Institute; 1993.

C. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association; 1999.

D. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association; 2006.

E. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate locations and mounting heights of each type of hardware, schedules, catalog cuts, and installation details..
   2. Submit manufacturer's parts lists and templates.

C. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

D. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

E. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

F. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in

Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

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

B. Hardware Supplier Qualifications: Company specializing in supplying commercial door hardware approved by manufacturer.

1.07 PRE-INSTALLATION CONFERENCE

A. All keying must be approved by the owner at a pre-installation conference before hardware is ordered.

1.08 DELIVERY, STORAGE, AND PROTECTION

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

1.09 COORDINATION

A. Coordinate the work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware.

B. Furnish templates for door and frame preparation.

C. Coordinate with all Owner keying requirements during the course of the Work.

1.10 WARRANTY

A. See Section 01780 - Closeout Submittals, for additional warranty requirements.

B. Provide five year warranty for door closers.

1.11 MAINTENANCE PRODUCTS

A. Provide special wrenches and tools applicable to each different or special hardware component.

B. Provide maintenance tools and accessories supplied by hardware component manufacturer.

PART 2 PRODUCTS:

2.01 MANUFACTURERS AND PRODUCTS: Furnish the following products as specified and/or scheduled or request permission for substitution at least 10 days prior to bid date.

A. Hinges: Full Mortise, 5-knuckle, Ball bearing type
   1. McKinney Products Company: www.mckinneyhinge.com
      a. T4A3386, TA2714, T4A3786, TA2314
   2. Hager Companies: www.hagerhinge.com.
      a. BB1199, BB1279, BB1168, BB1193
   3. Stanley Hardware: www.stanleyworks.com.
      a. FBB199, FBB168, FBB179, FBB191
   4. Provide non-removable heavy duty hinges at all exterior doors and outswing storage doors and as scheduled.

B. Pivots:
   1. DORMA Group North America: www.dorma-usa.com/usa.
   2. Glynn-Johnson: www.glynn-johnson.com.
   3. McKinney Products Company: www.mckinneyhinge.com.

C. Lock and Latch Sets: Full Mortised type
   1. Best Access Systems: www.bestlock.com

a. 35H 3H US26D
2. Sargent Manufacturing Company: www.sargentlock.net
a. 8200 LNJ US26D
3. Schlage: www.schlage.com.
a. 9000 93A US26D

D. Push/Pulls:
1. Rockwood
2. Hager Companies: www.hagerhinge.com.
3. Hiawatha, Inc: www.hiawathainc.com.
4. Triangle Brass Manufacturing Co., Inc: www.trimcobbw.com.

E. Lock Cylinders:
1. Best Access Systems: www.bestlock.com
2. Sargent Manufacturing Company: www.sargentlock.net
3. Schlage: www.schlage.com.

F. Exit Devices:
1. Precision
a. 1000 SERIES US32D
2. Sargent Manufacturing Company : www.sargentlock.net
a. 88 SERIES US32D
3. Von Duprin: www.vonduprin.com.
a. 99 SERIES US26D

G. Closers:
1. Ryobi Closers: www.ryobi-group.co.jp/en/projects/builder/profile.html
a. D4550 SERIES
2. Sargent Manufacturing Company : www.sargentlock.net
a. 281 SERIES
3. LCN: www.lcnclosers.com.
a. 4041 SERIES
4. Yale Commercial Locks and Hardware: www.yalelocks.com.
a. D4550 SERIES

H. Overhead Stops:
1. Gynn-Johnson
a. 900 SERIES US32D; 454 SERIES US32D
2. ABH
a. 9020 SERIES US32D; 4400 SERIES US32D
3. Sargent Manufacturing Company : www.sargentlock.net
a. 590 SERIES US26D; 1540 SERIES US26D
4. Sargent Manufacturing Company: www.sargentlock.com.

I. Manual Bolts:
1. Glynn-Johnson: www.glynn-johnson.com.
2. Hager Companies: www.hagerhinge.com.
3. Triangle Brass Manufacturing Co., Inc: www.trimcobbw.com.

J. Gasketing:
1. National Guard Products, Inc: www.ngpinc.com.
2. Pemko Manufacturing Co: www.pemko.com.
3. Zero International, Inc: www.zerointernational.com.

K. Protection Plates:
1. Hager Companies: www.hagerhinge.com.
2. Hiawatha, Inc: www.hiawathainc.com.

3. Triangle Brass Manufacturing Co., Inc: www.trimcobbw.com.

2.02 GENERAL REQUIREMENTS FOR DOOR HARDWARE PRODUCTS

A. Provide products that comply with the following:
   1. Applicable provisions of Federal, State, and local codes.
   2. ANSI/ICC A117.1, American National Standard for Accessible and Usable Buildings and Facilities.
   3. Applicable provisions of NFPA 101, Life Safety Code.
   4. Fire-Rated Doors: NFPA 80.
   5. All Hardware on Fire-Rated Doors: Listed and classified by UL as suitable for the purpose specified and indicated.
   6. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

B. Finishes: Identified in schedule at end of section.

C. At all wood doors, through bolts shall be used for the attachment of all closers, overhead holders, and exit devices.

D. Provide Door Silencers at all doors. Install three at single doors up to 7'-2" high, four at single doors over 7'-2" high, and two at each pair of doors.

2.03 KEYING

A. Door Locks: All locks shall be Grand master keyed per the owner's requirements.

B. Locksets shall be provided with construction key cores. Construction keyed cores shall be replaced with 'permanent' cores in the presence of the owner's representative and all keys and a key bitting schedule shall be supplied to the owner at that time.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.

B. Verify that electric power is available to power operated devices and of the correct characteristics.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Use templates provided by hardware item manufacturer.

C. Install hardware on fire-rated doors and frames in accordance with code and NFPA 80.

D. Mounting heights for hardware from finished floor to center line of hardware item:
   1. For steel doors and frames: Comply with DHI "Recommended Locations for Architectural Hardware for Steel Doors and Frames."
   2. For wood doors: Comply with DHI "Recommended Locations for Architectural Hardware for Wood Flush Doors."
   3. For hardware: Comply with North Carolina Accessibility Code 7.9.2 (ADAAG 4.13.9).

3.03 ADJUSTING & CLEANING

A. Adjust work under provisions of Section 01700.

B. Clean all hardware and adjust for smooth operation.

3.04 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01700.

B. Do not permit adjacent work to damage hardware or finish.

3.05 HARDWARE SCHEDULE: APPENDED TO END OF SECTION

END OF SECTION

DATE: 05-23-2007 JOB# L7068S

WILKES CO. VISITORS CENTER
WILKESBORO CO. NC

SECTION 08710- FINISH HARDWARE

FURNISH THE FOLLOWING PRODUCTS OR REQUEST PERMISSION FOR SUBSTITUTION ***TEN DAYS PRIOR TO BID DATE.***

HINGES:
HAGER----------BB1199----------BB1279---BB1168-----BB1193
MCKINNEY---------T4A3386---------TA2714---T4A3786----TA2314
STANLEY----------FBB199----------FBB168---FBB179-----FBB191

EXIT DEVICES:
SARGENT----------88 SERIES US32D
VON DUPRIN-------99 SERIES US26D
PRECISION--------2000 SERIES US32D

LOCKS:
SARGENT----------8200 LNJ US26D
SCHLAGE----------9000 93A US26D
BEST----------35H 3H US26D

CLOSERS:
SARGENT----------281 SERIES
LCN----------4041 SERIES
RYOBI----------D4550 SERIES

OH STOPS
GLYNN JOHNSON: 900 SERIES-------US32D
454 SERIES-------US32D
ABH: 9020 SERIES-----US32D
4400 SERIES-----US32D
RIXSON: 10-300 SERIES—US32D
9-300 SERIES----US32D

SEE ALT. FOR OWNERS PREFERED PRODUCTS.

MANUFACTURERS USED LIST
CODE MANUFACTURERS NAME
---- ----------
GL GLYNN JOHNSON
IV H.B IVES
MC MCKINNEY
PE PEMKO
RO ROCKWOOD
RX RIXSON-FIREMARK
SA SARGENT

Group # 1			
ALUM DRS & FR.			
1 MORTISE CYLINDER	11 6342	26D	SA
Group # 2			
3 HINGES	TA2714 4 1/2 X 4 1/2	26D	MC
1 LOCKSET	11 8204 LNJ	26D	SA
1 WALL BUMPER	409	US32D	RO
3 DOOR SILENCER	GJ64	GRAY	GL

Group # 3			
3 HINGES	TA2714 4 1/2 X 4 1/2	26D	MC
1 LOCKSET	11 8205 LNJ	26D	SA
1 WALL BUMPER	409	US32D	RO
3 DOOR SILENCER	GJ64	GRAY	GL
Group # 4			
3 HINGES	TA2714 4 1/2 X 4 1/2	26D	MC
1 PRIVACY SET	8265 LNJ	26D	SA
1 WALL BUMPER	409	US32D	RO
3 DOOR SILENCER	GJ64	GRAY	GL
Group # 5			
3 HINGES	TA2714 4 1/2 X 4 1/2	26D	MC
1 LOCKSET	11 76 8204 LNJ	26D	SA
1 CLOSER	281 PS	EN	SA
1 SMOKE SEAL	S88 W 17'		PE
Group # 6			
3 HINGES	TA2714 4 1/2 X 4 1/2	26D	MC
1 LOCKSET	11 8205 LNJ	26D	SA
1 CLOSER	281 O	EN	SA
1 PROTECTION PLATE	K1050 10" X 34"	US32D	RO
1 OVERHEAD STOP	9-336	630	RX
1 SMOKE SEAL	S88 W 17'		PE
Group # 7			
6 HINGES	T4A3386 4 1/2 X 4 1/2 NRP	32D	MC
2 FLUSH BOLTS	555	US26D	RO
1 LOCKSET	8225 LNJ	26D	SA
1 CLOSER	281 PSH	EN	SA
ACTIVE LEAF			
2 PROTECTION PLATE	K1050 10" X 34"	US32D	RO
1 OVERHEAD HOLDER	9-326	630	RX
INACTIVE LEAF			
1 THRESHOLD	171 A 72"		PE
2 DOOR BOTTOM SWEEP	3452 CNB 36"		PE
1 WEATHERSTRIP	2902 AV 1 X 72" + 2 X 84"		PE
1 RAINDRIP	346 C X 76"		PE
2 ASTRAGAL	29324 CNB X 84"		PE
Group # 8			
6 HINGES	T2714 4 1/2 X 4 1/2	26D	MC
2 FLUSH BOLTS	555	US26D	RO
1 DUST PROOF STRIKE	570	US26D	RO
1 LOCKSET	11 8237 LNJ	26D	SA
2 OVERHEAD HOLDER	10-346	630	RX
2 DOOR SILENCER	GJ64	GRAY	GL
Group # 9			
3 HINGES	TA2714 4 1/2 X 4 1/2	26D	MC
1 LOCKSET	11 8204 LNJ	26D	SA
1 CLOSER	281 O	EN	SA
1 WALL BUMPER	409	US32D	RO
1 SMOKE SEAL	S88 W 17'		PE

Group # 10			
6 HINGES	T4A3386 4 1/2 X 4 1/2 NRP	32D	MC
2 FLUSH BOLTS	555	US26D	RO
1 LOCKSET	11 76 8204 LNJ	26D	SA
1 CLOSER	281 PSH	EN	SA
ACTIVE LEAF			
2 PROTECTION PLATE	K1050 10" X 34"	US32D	RO
1 OVERHEAD HOLDER	9-326	630	RX
INACTIVE LEAF			
1 LOCK GUARD	LG10	US32D	IV
1 THRESHOLD	171 A 72"		PE
2 DOOR BOTTOM SWEEP	3452 CNB 36"		PE
1 WEATHERSTRIP	2902 AV 1 X 72" + 2 X 84"		PE
1 RAINDRIP	346 C X 76"		PE
2 ASTRAGAL	29324 CNB X 84"		PE
Group # 11			
3 HINGES	T4A3386 4 1/2 X 4 1/2 NRP	32D	MC
1 LOCKSET	11 8204 LNJ	26D	SA
1 OVERHEAD HOLDER	9-326	630	RX
1 LOCK GUARD	LG10	US32D	IV
1 THRESHOLD	171 A 36"		PE
1 DOOR BOTTOM SWEEP	3452 CNB 36"		PE
1 WEATHERSTRIP	2902 AV 1 X 36" + 2 X 84"		PE
1 RAINDRIP	346 C X 40"		PE
Group # 12			
3 HINGES	TA2714 4 1/2 X 4 1/2	26D	MC
1 LOCKSET	11 8204 LNJ	26D	SA
1 WALL BUMPER	409	US32D	RO
3 DOOR SILENCER	GJ64	GRAY	GL
Group # 13			
3 HINGES	TA2314 4 1/2 X 4 1/2	32D	MC
1 LOCKSET	50 11 8267 LNJ	26D	SA
1 CLOSER	281 O	EN	SA
1 PROTECTION PLATE	K1050 10" X 34"	US32D	RO
1 WALL BUMPER	409	US32D	RO
3 DOOR SILENCER	GJ64	GRAY	GL
Group # 14			
3 HINGES	TA2314 4 1/2 X 4 1/2	32D	MC
1 LOCKSET	11 8204 LNJ	26D	SA
1 CLOSER	281 O	EN	SA
1 PROTECTION PLATE	K1050 10" X 34"	US32D	RO
1 THRESHOLD	171 A 36"		PE
1 DOOR BOTTOM SWEEP	3452 CNB 36"		PE
1 WEATHERSTRIP	2902 AV 1 X 36" + 2 X 84"		PE
Group # 15			
3 HINGES	T4A3386 4 1/2 X 4 1/2 NRP	32D	MC
1 LOCKSET	11 8204 LNJ	26D	SA
1 CLOSER	281 PSH	EN	SA
1 LOCK GUARD	LG10	US32D	IV
1 THRESHOLD	171 A 36"		PE
1 DOOR BOTTOM SWEEP	3452 CNB 36"		PE
1 WEATHERSTRIP	2902 AV 1 X 36" + 2 X 84"		PE
1 RAINDRIP	346 C X 40"		PE

SECTION 08800

GLAZING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Glass- Pre-Glazed and Site Glazed.

B. Glazing compounds and accessories.

1.03 DESCRIPTION OF WORK:

A. Extent of glass and glazing work is indicated on drawings and schedules.

B. See Window, Door, and Hollow Metal Schedules on the Drawings and the Glazing Schedule at the end of this section.

1.04 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 07260 - Vapor Retarders.

D. Section 07900 - Joint Sealers: Sealant and back-up material.

E. Section 08110 - Steel Doors and Frames: Glazed doors and borrowed lites.

F. Section 08211 - Flush Wood Doors: Glazed doors.

G. Section 08410 - Metal-Framed Storefronts.

H. Section 08460 - Automatic Entrance Doors.

1.05 REFERENCES

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2004.

C. ASTM C 864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 1999 (Reapproved 2005).

D. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants; 2002.

E. ASTM C 1036 - Standard Specification for Flat Glass; 2001.

F. ASTM C 1193 - Standard Guide for Use of Joint Sealants; 2005.

G. ASTM E 773 - Standard Test Method for Accelerated Weathering of Sealed Insulating Glass Units; 2001.

H. ASTM E 774 - Standard Specification for the Classification of the Durability of Sealed Insulating Glass Units; 1997.

I. ASTM E 1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2004.

J. GANA (GM) - GANA Glazing Manual; Glass Association of North America; 2004.

K. GANA (SM) - FGMA Sealant Manual; Glass Association of North America; 1990.

1.06 PERFORMANCE REQUIREMENTS

A. Provide glass and glazing materials for continuity of building enclosure vapor retarder and air barrier:
   1. In conjunction with vapor retarder and joint sealer materials described in other sections.
   2. To utilize the inner pane of multiple pane sealed units for the continuity of the air barrier and vapor retarder seal.
   3. To maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.

B. Select type and thickness of exterior glass to withstand dead loads and wind loads acting normal to plane of glass at design pressures of 50 lb/sq ft positive and negative.
   1. Use the procedure specified in ASTM E 1300 to determine glass type and thickness.
   2. Limit glass deflection to L / 175 or flexure limit of glass, whichever is less, with full recovery of glazing materials.
   3. Thicknesses listed are minimum.

C. Provide tempered safety glass of type indicated unless governing authorities require more stringent type due to location.

D. Provide glass and glazing that has been produced, fabricated and installed to withstand normal thermal movement, wind loading and impact loading (where applicable), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials and other defects in the work.

1.07 DEFINITIONS

A. Sealed Insulating Glass Unit Surfaces
   1. Side 1 - Exterior surface of outer pane (outside building).
   2. Side 2 - Interior surface of outer pane.
   3. Side 3 - Interior surface of inner pane.
   4. Side 4 - Exterior surface of inner pane (inside building).

B. Deterioration of insulating glass is defined as failure of hermetic seal due to other causes than breakage which results in intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coating, if any, resulting from seal failure, and any other visual evidence of seal failure or performance.

C. Deterioration of laminated glass is defined as the development of manufacturing defects including edge separation or delamination which materially obstructs vision through glass.

D. Deterioration of coated glass is defined as the development of manufacturing defects including peeling, cracking or other indications of deterioration in metallic coating due to normal conditions of use.

1.08 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.

C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.

D. Samples: Submit two samples 6 x 6 inch in size of glass units.

E. Samples: Submit 6 inch long bead of glazing sealant, color as selected.

F. Certificates: Certify that products meet or exceed specified requirements.

G. Manufacturer's Certificate: Certify that sealed insulated glass meets or exceeds specified requirements.

H. LEED Report: Submit for recycled contents and loccally harvested and manufactured materials and products.

1.09 QUALITY ASSURANCE

A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not install glazing when ambient temperature is less than 50 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.11 WARRANTY

A. See Section 01780 - Closeout Submittals, for additional warranty requirements.

B. Provide a ten (10) year warranty to include coverage for sealed glass units from seal failure, including interpane dusting or misting, film formation, moisture collection, or visual obstruction. Include provision for replacement of failed units.

C. Provide a ten (10) year warranty to include coverage for delamination of laminated glass and replacement of same.

PART 2 PRODUCTS

2.01 FLAT GLASS MATERIALS

A. Manufacturers:
   1. AFG Industries, Inc: www.afgglass.com.
   2. Pilkington Building Products North America: www.pilkington.com.
   3. PPG Industries, Inc: www.ppg.com.
   4. Unicel Architectural, Inc: www.visioncontrol.qc.ca
   5. Visteon Glass Systems: www.visteon.com/floatglass.
   6. Substitutions: Refer to Section 01600 - Product Requirements.

B. Clear Float Glass (Type CF): Clear, annealed.
   1. Acceptable Product: Pilkington Optfloat or approved equal.
   2. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
   3. Visible Light Transmittance: Minimum 89 percent.
   4. Visible Light Reflectance: 8 percent.
   5. Total Solar Energy Transmittance: 78 percent.
   6. Total Solar Energy Reflectance: 7 percent.
   7. UV Transmittance: 62 percent.
   8. 6 mm minimum thick.

C. Clear Tempered Safety Glass (Type TS): Clear; fully tempered with horizontal tempering (kind FT).
   1. Light Transmittance: Minimum 90%
   2. Comply with 16 CFR 1201 test requirements for Category II.
   3. Comply with ANSI Z97.1.

4. 6 mm minimum thick.

D. Tinted Glass (Type TN): Float type, heat strengthened, grey color.
   1. Acceptable Product: Pilkington Optfloat or approved equal.
   2. Light transmittance of 44 percent, shading coefficient of.66.
   3. Comply with ASTM C 1036, Type I, transparent flat, Class 2 tinted heat-absorbing and light reducing, Quality Q3 (glazing select).
   4. 6 mm minimum thick.

E. Low E Glass (Type LE): Float type, heat strengthened, clear.
   1. Sputtered coating on inner surface.
   2. Visible light transmittance of 82 percent, solar light transmittance of 65 percent, shading coefficient of.81.
   3. 6 mm minimum thick.

F. Wired Glass (Type WG): Clear.
   1. Stainless steel wire in square mesh pattern.
   2. 1/2 inch grid size.
   3. Polished both sides.
   4. 1/4 inch thick.

2.02 SEALED INSULATING GLASS MATERIALS

A. Manufacturers:
   1. As specified for Flat Glass Materials.
   2. Substitutions: Refer to Section 01600 - Product Requirements.

B. Uncoated Insulated Glass Units (Type IG-U): Double pane with glass to elastomer edge seal.
   1. Outer pane of TS glass, inner pane of TS glass.
   2. Comply with ASTM E 774 and E 773, Class CBA.
   3. Purge interpane space with dry hermetic air.
   4. Total unit thickness of 1 inch minimum.
   5. Performance Characteristics: Visible light transmittance of at least 80%; summer daytime U-Value of 0.55; winter nighttime U-Value of 0.48; shading coefficient of 0.83; and outdoor reflectance of 14%.

C. Low-E Insulated Glass Units (Type IG-E): Double pane with glass to elastomer edge seal, cavity filled with Argon gas.
   1. Outer pane of LE glass, inner pane of CF glass.
      a. Provide CF or TG depending on code requirements for specific situation.
   2. Sputtered low E coating on No.2 surface within the unit.
   3. Comply with ASTM E 774 and E 773, Class CBA.
   4. Purge interpane space with dry hermetic air.
   5. Total unit thickness of 1 inch minimum, unless otherwise noted. Provide 5/8 inch unit for active leaf of automatic entrance door in accordance with Section 08460.
   6. Performance Characteristics: Visible light transmittance of at least 72%, summer daytime U-value of 0.34; winter nighttime U-value of 0.37; shading coefficient of 0.78; and outdoor solar reflectance of 13%.

D. Tinted Low E Insulated Glass Units (Type IG-TE): Double pane with glass to elastomer edge seal, cavity filled with Argon gas.
   1. Outer pane of TN glass, inner pane of LE glass.
      a. Provide CF or TS depending on code requirements for specific situation.
   2. Sputtered low E coating on No. 3 surface; Sputtered tinting on No. 2 surface within the unit as scheduled.
   3. Comply with ASTM E 774 and E 773, Class CBA.
   4. Purge interpane space with dry hermetic air.

5. Total unit thickness of 1 inch minimum.
6. Performance Characteristics: Visible light transmittance of at least 32%, summer daytime U-value of 0.38; winter nighttime U-value of 0.35; shading coefficient of 0.70; and outdoor solar reflectance of 29%.

E. Edge Seal Construction: Stainless steel, bent and soldered corners.

F. Edge Seal Material: black color.

2.03 GLAZING COMPOUNDS

A. Manufacturers:
1. Bostik, Inc: www.bostik-us.com.
2. GE Plastics; www.geplastics.com.
3. Pecora Corporation: www.pecora.com.
4. Substitutions: Refer to Section 01600 - Product Requirements.

B. Acrylic emulsion latex (Type JS5); ASTM C 834, single component, paintable.

C. Acrylic Sealant (Type JS11): Single component, solvent curing, non-bleeding; ASTM C 920, Type S, Grade NS, Class 12-1/2, Uses M and A; cured Shore A hardness of 15 to 25; color as selected.

D. Polysulfide Sealant (Type JS12): Two component; chemical curing, non-sagging type; ASTM C 920, Type M, Grade NS, Class 25, Uses M, A, and G; cured Shore A hardness of 15 to 25; color as selected.

E. Polyurethane Sealant (Type JS1): Single component, chemical curing, non-staining, non-bleeding; ASTM C 920, Type S, Grade NS, Class 25, Uses M, A, and G; Shore A Hardness Range 20 to 35; color as selected.

F. Silicone Sealant (Type JS2): Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C 920, Type S, Grade NS, Class 25, Uses M, A, and G; cured Shore A hardness of 15 to 25; color as selected.

2.04 GLAZING ACCESSORIES

A. Setting Blocks: Silicone, 80 to 90 Shore A durometer hardness, ASTM C 864 Option I. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

B. Spacer Shims: Silicone, 50 to 60 Shore A durometer hardness, ASTM C 864 Option I. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.

C. Glazing Tape: Preformed polysulfide compound with integral resilient tube spacing device; 10 to 15 Shore A durometer hardness; coiled on release paper; 1/16x3/8 inch and 1/8x3/8 inch size; black color.

D. Glazing Tape: Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air barrier and vapor retarder seal; 1/16x3/8 inch size.

E. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C 864 Option I; clear color.

F. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings for glazing are correctly sized and within tolerance.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

C. Glazier shall be required to inspect work of glass framing erector for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for presence and functioning of weep system; for existence of minimum required face or edge clearances; and for effective sealing of joinery. Obtain Glazier's written report listing conditions detrimental to performance of glazing work. Do not allow glazing work to proceed until all unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

B. Prime surfaces scheduled to receive sealant in accordance with manufacturer's instructions.

C. Clean and dry glazing channels and other framing members to receive glass immediately before glazing. Remove coatings which are not firmly bonded to substrate. Remove lacquer from metal surfaces where elastomeric sealants are indicated for use.

D. Install sealants in accordance with ASTM C 1193 and FGMA Sealant Manual.

E. Install sealant in accordance with manufacturer's instructions.

3.03 GLAZING- GENERAL

A. Comply with combined printed recommendations of glass manufacturers and of manufacturers of sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those of referenced glazing standards.

B. Glazing channel dimensions as indicated in details are intended to provide for necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by job conditions at time of installation.

C. Protect glass from edge damage during handling and installation; use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass with flares or bevels along one horizontal edge which would occur in vicinity of setting blocks so that these are located at top of opening. Remove from project and dispose of glass units with edge damage or other imperfections of kind that, when installed, weakens glass and impairs performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

3.04 INSTALLATION- EXTERIOR WET/DRY METHOD (PREFORMED TAPE AND SEALANT)

A. Cut glazing tape to length and set against permanent stops, 3/16 inch below sight line. Seal corners by butting tape and dabbing with polysulfide - JS12 sealant.

B. Apply heel bead of polysulfide - JS12 sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.

C. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

D. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.

E. Install removable stops, with spacer strips inserted between glazing and applied stops, 3/8 inch

below sight line. Place glazing tape on glazing pane or unit with tape flush with sight line.

F. Fill gap between glazing and stop with polysulfide - JS12 type sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch below sight line.

G. Apply cap bead of polysulfide - JS12 type sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.05 INSTALLATION- INTERIOR WET/DRY METHOD (TAPE AND SEALANT)

A. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.

B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

C. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.

D. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.

E. Fill gaps between pane and applied stop with acrylic emulsion latex - JS5 type sealant to depth equal to bite on glazing, to uniform and level line.

F. Trim protruding tape edge.

3.06 INSTALLATION- INTERIOR WET METHOD (COMPOUND AND COMPOUND)

A. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 24 inch centers, kept 1/4 inch below sight line.

B. Locate and secure glazing pane using glazers' clips.

C. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.

3.07 PROTECTION AND CLEANING

A. Protect exterior glass from breakage immediately upon installation by use of crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove immediately by method recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less often than once a month, for build-up of dirt, scum, alkali deposits or staining. When examination reveals presence of these forms of residue, remove by method recommended by glass manufacturer.

D. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

E. Remove labels after Work is complete.

F. Clean glass and adjacent surfaces.

3.08 PROTECTION OF FINISHED WORK

A. Wash glass on both faces not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion in each area of project. Wash glass by method recommended by glass manufacturer.

3.09 WASTE MANAGEMENT

A. Separate float glass and place in designated area for reuse or recycling.

B. Separate tempered glass for use as aggregate or non-structural fill.

C. Separate plastic materials adn place in designated area for reuse or recycling.

D. Separate corrugated cardboard in accordance with the Waste Management Plan and place in designated area for recycling.

3.10 END OF SECTION

SECTION 09260

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Acoustic insulation at designated wood stud framed walls.

B. Standard and fire rated gypsum board panels.

C. Exterior gypsum soffit and ceiling board.

D. Joint treatment and accessories.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 06100 - Rough Carpentry: Building framing.

D. Section 07212 - Board and Batt Insulation: Acoustic insulation.

E. Section 07900 - Joint Sealers: Acoustic sealant.

F. Section 07900 - Joint Sealers

G. Section 08310 - Access Doors and Panels

H. Section 09900 - Paints and Coatings

I. Section 12075 - Translucent Fabric Baffles: Wood blocking for support of baffles

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on gypsum board, accessories, joint finishing system, and joint finishing system.

C. LEED Submittals:
   1. For gypsum wallboard, submit documentation of recycled content and location of manufacture.

1.05 QUALITY ASSURANCE

A. Perform in accordance with ASTM C 840. Comply with requirements of GA-600 for fire-rated assemblies.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable code for fire rated assemblies as indicated on drawings.

PART 2 PRODUCTS

2.01 GYPSUM BOARD MATERIALS

A. Gypsum Wallboard: Synthetic; 100% recycled paper face; ASTM C 1396/C 1396M. Sizes to minimize joints in place; ends square cut.
   1. Thickness: 5/8 inch or as indicated on the drawings..
   2. Edges: Tapered.

B. Type X: Synthetic; 100% recycled paper face; Fire resistant, UL or WH rated.
   1. Application: Where required for fire-rated assemblies, unless otherwise indicated.
      a. Thickness: 5/8 inch.

C. Moisture-Resistant Gypsum Board: Synthetic; 100% recycled paper face; ASTM C 630/C 630M; ends square cut.
   1. Application: Toilet Room.
   2. Core Type: Regular and Type X, as indicated.
   3. Thickness: 5/8 inch, as indicated.
   4. Edges: Tapered.

D. Exterior Gypsum Soffit Board: Synthetic; 100% recycled paper face; ASTM C 1396/C 1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Ceilings and soffits in protected exterior areas, unless otherwise indicated.
   2. Core Type: Regular.
   3. Thickness: 5/8 inch.
   4. Edges: Tapered.

2.02 ACCESSORIES

A. Acoustic Insulation: ASTM C 665; preformed glass fiber, friction fit type, unfaced. Minimum Thickness: 2-1/2 inch.

B. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board as specified in Section 07900.

C. Joint Materials: ASTM C 475 and as recommended by gypsum board manufacturer for project conditions.
   1. Ready-mixed vinyl-based joint compound.
   2. Powder-type vinyl-based joint compound.

D. Screws: ASTM C 1002; self-piercing tapping type; cadmium-plated for exterior locations.

E. Nails: ASTM C 514.

F. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install as follows:
   1. Place one bead continuously on substrate before installation of perimeter framing members.
   2. Place continuous bead at perimeter of each layer of gypsum board.
   3. In non-fire-rated construction, seal around all penetrations by conduit, pipe, ducts, and rough-in boxes.

3.03 GYPSUM BOARD INSTALLATION

A. Comply with ASTM C 840 and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Gypsum Soffit Board: Install perpendicular to framing, with staggered end joints over framing members or other solid backing.

D. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For non-rated assemblies, install as follows:
   1. Single-Layer Applications: Screw attachment.

E. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

F. Moisture Protection: Treat cut edges and holes in exterior gypsum soffit board with sealant.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
   2. At exterior soffits, not more than 30 feet apart in both directions.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

3.05 JOINT TREATMENT

A. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

B. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.06 TOLERANCES

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

3.07 WASTE MANAGEMENT

A. Separate clean waste gypsum products from contaminants for recycling in accordance with Sections 01355 and 01732 and the Waste Management Plan. Do not include wood, plastic, metal, asphalt impregnated gypsum board or any gypsum board coated with glass fiber, vinyl, decorative paper, paint or other finish.

B. Clean waste gypsum products may be recycled by:
   1. Returning to gypsum board manufacturer.
   2. Pulverize and apply on-site as soil amendment in accordance with landscape specifications and as approved by the Landscape Architect. Do not use products containing glass fiber. Protect granular material from moisture.

C. Separate metal waste in accordance with the Waste Management Plan and place in designated area for recycling or reuse.

3.08 FINISH LEVEL SCHEDULE

A. Level 1: Above finished ceilings concealed from view.

B. Level 2: Utility areas and areas behind cabinetry.

C. Level 3: Walls scheduled to receive textured wall finish.

D. Level 4: Walls and ceilings scheduled to receive flat or eggshell paint finish and any surfaces not specifically scheduled.

E. Level 5: Walls and ceilings scheduled to receive semi-gloss or gloss paint finish.

END OF SECTION

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SECTION 09300

TILE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Tile for floor applications.

1.03 DESCRIPTION OF WORK:

A. Locations of tile work in this section include the following:
   1. Unglazed floor tile.

1.04 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 03300 - Cast in Place Concrete

D. Section 07900 - Joint Sealers.

1.05 REFERENCES

A. ANSI A108 Series/A118 Series/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 1999.
   1. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 1988.

B. TCA (HB) - Handbook for Ceramic Tile Installation; Tile Council of North America, Inc.; 2006.

1.06 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate tile layout.

C. Product Data: Written product information which demonstrates materials to be used on the project comply with contract documents, including recycled content. Provide instructions for using grouts and adhesives.

D. Samples (for initial selection by Architect): Manufacturer's color selection boards of actual tile materials and grout colors, including a complete selection of available tile colors and finishes for each tile type indicated. Include samples of accessory materials requiring color selection.

E. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

F. LEED Report: Submit for recycled contents and locally harvested and manufactured materials and products.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum 5 years of documented experience.

B. Installer Qualifications: Company specializing in performing tile installation, with minimum of approved by manufacturer years of documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Packaged materials shall be delivered and stored in original containers with seals unbroken and labels intact until time of use. Protect material from damage and store in dry location.

B. Precautions:
   1. Areas receiving tile shall be closed to traffic and other work while tile is being set.
   2. Prevent rapid evaporation of moisture from the mortar bed. The mortar setting bed shall not dry too far in advance of actual setting of tile, and in no case set on a dry bed.

C. Provide temperatures in tiled areas during installation and after completion as required by referenced installation standards or manufacturer's instructions but not less than 50 degrees F.

D. If it is necessary to use temporary heaters, vent units to exterior to protect tile work from carbon dioxide accumulation.

E. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Do not install adhesives in an unventilated environment.

1.10 EXTRA MATERIALS

A. Provide 2 percent of each size, color, and surface finish of tile specified, but not less than one carton of each type.

PART 2 PRODUCTS

2.01 TILE

A. Manufacturers:
   1. Dal-Tile Corporation: www.daltile.com. or approved equal.
   2. Substitutions: See Section 01600 - Product Requirements.

B. Quarry Tile: ANSI A137.1, and as follows:
   1. As manufactured manufactured by Dal-Tile or approved equivalent product.
   2. Moisture Absorption: 0.5 to 3.0 percent.
   3. Size and Shape: 6 inch square.
   4. Thickness: 3/8 inch.
   5. Edges: Square.
   6. Surface Finish: Plain unglazed.
   7. Colors: Ashen Grey 0T03 by Dal-Tile.
   8. Trim Units: Matching bullnose, cove, cove base, and window sill or step nosing shapes in sizes coordinated with field tile.

2.02 ADHESIVE MATERIALS

A. Tile Setting Materials: Portland Cement Mortar Installation Materials complying with ANSI A108.1 or Latex Portland Cement Mortar complying with ANSI A118.4 with one component dry grout mix field mixed with water or two-component dry grout mix and liquid latex additive field mixed.

2.03 MORTAR MATERIALS

A. Manufacturers:
   1. W.R. Bonsal Co: www.bonsal.com.
   2. Bostik, Inc: www.bostik-us.com.

3. Custom Building Products: www.custombuildingproducts.com.
4. Substitutions: See Section 01600 - Product Requirements.

B. Mortar Bed Materials: Portland cement, sand, latex additive and water.
1. Cement shall be quick-setting, non-staining, Portland Cement conforming to ASTM C-150, latest edition, Type 1.
2. Sand shall be sharp, clean, washed building sand in accordance with ASTM C-144, graded from fine to coarse as follows: For pointing mortar, 100% passing #30 screen and not more than 5% passing #100; all other work, 100% passing a #4 screen and not more than 5% passing #100 screen.
3. Water shall be clean, potable.

C. Mortar Bond Coat Materials:
1. Dry-Set Portland Cement type: ANSI A118.1.
2. Latex-Portland Cement type: ANSI A118.4.
3. Epoxy: ANSI A118.3.

2.04 GROUT MATERIALS

A. Manufacturers:
1. W.R. Bonsal Co: www.bonsal.com.
2. Bostik, Inc: www.bostik-us.com.
3. Custom Building Products: www.custombuildingproducts.com.
4. Substitutions: See Section 01600 - Product Requirements.

B. Grouting Materials, color as selected by the Architect:
1. Provide chemical resistant epoxy grout, ANSI A118.3, 6000 TCA Formulation AAR-11 HT Epoxy Grout, at toilet areas with quarry tile materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.

B. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

3.03 INSTALLATION - GENERAL

A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1 through A108.13, manufacturer's instructions, and TCA Handbook recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.

E. Sound tile after setting. Replace hollow sounding units.

F. Keep expansion joints free of adhesive or grout. Apply sealant to joints.

G. Allow tile to set for a minimum of 48 hours prior to grouting.

H. Grout tile joints. Use standard grout unless otherwise indicated.

I. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.04 INSTALLATION- FLOORS - MORTAR BED METHODS

A. Over interior concrete substrates, install in accordance with TCA Handbook Method F111, with cleavage membrane, unless otherwise indicated.
   1. Where epoxy bond coat and grout are indicated, install in accordance with TCA Handbook Method F132, bonded.
   2. Where epoxy grout is indicated, but not epoxy bond coat, install in accordance with TCA Handbook Method F114, with cleavage membrane.

B. Cleavage Membrane: Lap edges and ends.

C. Mortar Bed Thickness: 1-1/4 inch, unless otherwise indicated.

3.05 CLEANING

A. Clean tile and grout surfaces.
   1. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
   2. Remove temporary wax coating from quarry tile, using methods recommended by manufacturers of tile and grout.
   3. Wipe latex-portland cement residue from tile with a damp cloth or sponge as soon as possible after tile installation.
   4. Replace any broken, chipped, marred, or otherwise damaged tile before final acceptance.

3.06 PROTECTION OF FINISHED WORK

A. Leave finished installation clean and free of cracked, chipped, broken, unbonded, or otherwise defective tile work.

B. Protection: Apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage and wear.
   1. Prohibit foot and wheel traffic from using tiled floors for at least 7 days after grouting is completed.
   2. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.
   3. Provide coat of wax on finish tile floor if required by owner.

3.07 WASTE MANAGEMENT

A. Separate waste in accordance with Sections 01355, 01732 and the Waste Management Plan and place in designated areas in the following categories for recycling:
   1. Half tiles and larger, set aside for reuse by Owner, donation to non-profit organizations such as Habitat for Humanity, etc.
   2. Broken tile and cutoffs smaller than 1/2 tile, excess mortar and grout, crush for use as mosaic, sub-base or non-structural fill.
   3. Separate cardboard waste and place in designated area for recycling.

END OF SECTION

SECTION 09511

SUSPENDED ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Non rated acoustical tile ceilings, including:
   1. Suspended metal grid system.
   2. Acoustical tile units.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 07900 - Joint Sealers: Acoustical sealant.

D. Section 09260 - Gypsum Board Assemblies: Acoustical insulation

E. Section 16510 - Lighting Fixtures and Lamps.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer"s product specifications and installation instructions for each acoustical ceiling material required, and for each suspension system, including certified laboratory test reports and other data as required to show compliance with these specifications, including amount of recycled contents.

C. Include manufacturer's recommendations for cleaning and refinishing acoustical units, including precautions against materials and methods which may be detrimental to finishes and acoustical performances.

D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

E. LEED Report: Submit for recycled contents and locally harvested and manufactured materials and products.

1.05 QUALITY ASSURANCE

A. Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other work supported by or penetrating through, ceilings, including light fixtures, HVAC equipment, and wall partitions.

B. Uniformity: Provide products of same manafacturer for each type of panel and grid required.

C. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

E. Installer Qualifications: firm with not less than three years of successful experience in

installation of acoustical ceilings similar to requirements for this project and which is acceptable to manufacturer of acoustical units, as shown by current written statement from manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING:

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination or other causes.
   1. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
   2. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.
      a. Coordination data: Prepare and distribute to affected installers necessary data for coordination with related work. Include setting diagrams showing placement of attachment devices for acoustical ceiling hangers.
      b. Within each space to receive products, do not begin installation until the following conditions are met:
         1) Work above ceilings has been finished, tested and approved.
         2) All radiant barrier material has been properly taped and accepted by Architect.
         3) Space is properly enclosed and protected from weather.
         4) Any "wet work" within the space is dry.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.08 PROJECT CONDITIONS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Install acoustical units after interior wet work is dry.

1.09 EXTRA MATERIALS

A. See Section 01600 - Product Requirements, for additional provisions.

B. Deliver stock of maintenance material to Owner. Furnish maintenance material matching products installed, packaged with protective covering for storage and identified with appropriate labels.
   1. Acoustical Ceiling Units: Furnish quantity of full-size units equal to 2% of each type installed.
   2. Exposed Suspension Components: Furnish quantity of each exposed component required for actual installation equal to 2% of each type installed.

PART 2 PRODUCTS

2.01 ACOUSTICAL CEILING UNITS

A. General:
   1. Standard for Acoustical Ceiling Units: Provide manufacturer"s standard units of configuration indicated which are prepared for mounting method designated and which comply with ASTM E 1264 for Class A materials and FS SS-D-118 requirements, including those indicated by reference to type, form pattern, grade (NRC or NIC as applicable), light reflectance coefficient (LR), edge detail, and joint detail (if any).
      a. Mounting Method for Measuring NRC: No. 7 (mechanically mounted on special metal support), FS SS-S-118; or Type E-400 mounting as per ASTM E 795.

2. Sound Attenuation Performance: Provide acoustical ceiling units with ratings for ceiling sound transmission class (STC) of range indicated as determined according to AMA 1-II "Ceiling Sound Transmission Test by Two-Room Method" with ceilings continuous at partitions and supported by a metal suspension system of type appropriate for ceiling unit of configuration indicated (concealed for tile, exposed for panels).
3. Colors, Textures, and Patterns: Provide products to match appearance characteristics indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors, surface textures, and patterns available for acoustical ceiling units and exposed metal suspension system members of quality designated.
4. Fire Spread Rating: Surface burning characteristics of 25 or less flame spread and 50 or less for smoke developed per ASTM E - 84.

B. Manufacturers:
1. Armstrong World Industries, Inc: www.armstrong.com.
2. BPB Celotex: www.bpb-na.com.
3. USG: www.usg.com.
4. Substitutions: See Section 01600 - Product Requirements.

C. Acoustical Panels: Wet-formed mineral fiber, ASTM E 1264 Type III, with the following characteristics:
1. Light Reflectance: 86 percent, determined as specified in ASTM E 1264.
2. NRC Range: 55, determined as specified in ASTM E 1264.
3. Edge: Square.
4. Surface Color: White.
5. Product: Georgian 764 by Armstrong.
6. Suspension System: Exposed grid.

2.02 METAL SUSPENSION SYSTEMS, GENERAL

A. Manufacturers:
1. Same as for acoustical units.
2. Substitutions: See Section 01600 - Product Requirements.

B. Suspension Systems - General: ASTM C 635; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.

C. Exposed Steel Suspension System: Formed galvanized steel, commercial quality cold rolled; heavy-duty.
1. Profile: Tee; 15/16 inch wide face.
2. Construction: Double web.
3. Finish: White painted.
4. Product: Prelude XL by Armstrong.

2.03 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Standard Perimeter Moldings: Same material and finish as grid.
1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.

C. Acoustical Insulation: As scheduled or shown on the drawings and specified in Section 09260.

D. Acoustical Sealant For Perimeter Moldings: Specified in Section 07900.

E. Gasket For Perimeter Moldings: Closed cell rubber sponge tape.

F. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION:

A. Coordination: Furnish layouts for inserts, clips, or other supports required to be installed by other trades for support of acoustical ceilings.
   1. Furnish hanger clips and similar devices to other trades for installation well in advance of time needed for coordination of other work.

B. Measure each ceiling area and establish layout of acoustical units as indicated on plans and verify all existing conditions for potential conflicts prior to establishing exact ceiling height and spacing.

C. Position ceiling components to maximize use of full-sized acoustical units and to provide border units which are equal in size and shape at opposing ceiling edges. Use of acoustical units which are smaller than 1/2 full width is prohibited at ceiling perimeters. Conform to reflected ceiling plans to greatest extent possible.

3.03 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C 636, ASTM E 580, and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360 Span.

C. Locate system on room axis according to reflected plan with edge units no less than 50 percent of acoustical unit size unless shown otherwise on the drawings.

D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

I. Do not eccentrically load system or induce rotation of runners.

J. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Install with continuous gasket.
   2. Use longest practical lengths.
   3. Miter corners.

3.04 INSTALLATION - ACOUSTICAL UNITS

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

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install units after above-ceiling work is complete.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:
   1. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.

G. Where round obstructions occur, provide preformed closures to match perimeter molding.

H. Lay acoustical insulation for a distance of 48 inches either side of acoustical partitions as indicated.

I. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.

J. Install hold-down clips on panels within 20 ft of an exterior door.

3.05 ERECTION TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.06 ADJUST AND CLEAN:

A. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage. Replace all damaged and stained tile.

3.07 WASTE MANAGEMENT

A. Separate Waste in accordance with Sections 01355 and 01732 and the Waste Management Plan

B. Store panels 1x2 feet or larger for use in patching and small infill areas.

C. Separate metal waste, packaging, and all other materials in accordance with the Waste Management Plan and place in designated area for recycling or reuse.

END OF SECTION

SECTION 09545

LINEAR SUSPENDED WOOD CEILING SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Metal suspension cliprail system with attched clip.

B. FSC certified linear wood strips and designated accessories.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 06100 - Rough Carpentry: Attaching suspension system to roof purlins.

D. Section 06181 - Glued-Laminated Structural Units.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's product specifications and installation instructions for all supplied materials.

C. Shop Drawings: Indicate placement of hangers, location of cliprails, and other related details.

D. Samples: Submit two wood strip sample, 9"x12" inch in size, illustrating selected wood specie and applied finish.

E. LEED Report: Submit for sustainably harvested wood, recycled content, and locally harvested and manufactured materials and products,
1.

F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum 2 years of experience.

B. Environmental Standard: The wood ceiling shall originate from well managed forests as certified by organizations accredited by the Forest Stewardship Council.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Deliver all materials to project site in original, labeled, and unopened packages.

B. Store materials flat and level under cover and elevated above grade. For a minimum of seventy-two (72) hours immediately prior to ceiling installation, the linear wood strips shall be stored in the room in which they will be installed. The temperature and humidity of the room shall closely approximate those conditions that will exist when the building is occupied.

C. Care in handling must be exercised to avoid damage.

1.07 PROJECT CONDITIONS

A. Sequence work to ensure ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Maintain the temperature and humidity closely approximate the interior conditions that will exist when the building is occupied. The heating and cooling systems shall be operating before, during, and after installation.

B. Maintain humidity between 25% and 55% during and after installation of the ceiling system.

1.09 WARRANTY

A. See Section 01780 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a one year period after Date of Substantial Completion.

C. Provide one year manufacturer warranty for all materials supplied by the ceiling manufacturer against manufacturing defect..

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Rulon Company; Product: Linear Suspended Wood Ceiling System; www.rulonco.com.

B. Other Acceptable Manufacturers:
   1. 9 WOOD; www.9wood.com.
   2. Woodceilings; www.woodceilings.com.
   3. Substitutions: See Section 01600 - Product Requirements.

2.02 WOOD STRIPS

A. Linear Wood Strips: Made from prime grade FSC certified wood in selected specie and finish. Manufactured in random lengths with tongue-and-groove ends.

B. Style: Standard linear, open style consisting of 4-1/2" modules; having wood strips 5/8" thick x 3-3/4" wide; and having a 3/4" reveal with factory-installed fiberfelt spacer between the wood strips. The open style fiberfelt spacer is provided in a standard black color.

C. Dimension Tolerances: + - 1/8".

D. Specie: Pine.

E. Texture: Smooth-sawn.

F. Finish: Factory-finished, high-grade, clear sealer.

2.03 SUSPENSION SYSTEMS

A. Suspension system shall consist of cliprails, installed on #12-gauge wire hangers supplied by installer.

B. Cliprails: Made from glavanized steel, 12 feet long, factory-fabricated with clips assembled into rails, and with hanger holes at regular intervals.

C. Clips: Made of spring-steel, with phosphate pretreatment and a corrosion-resistant coating. The clip allows individual board to be removed for above-ceiling maintenance.

2.04 ACCESSORIES

A. Perimeter Trims: Same specie and finish as wood strips, and FSC certifed, supplied by the ceiling manufacturer.

B. Edge Trims: Same specie and finish as wood strips, and FSC certified, supplied by the ceiling manufacturer, covering all edges of the ceiling.

PART 3 EXECUTION

3.01 PREPARATION

A. Ceiling Layout: Installer shall measure ceiling areas and establish the layout of the hangers and cliprails, in accordance with manufacturer's installation instruction.

B. Coordination: Installer shall furnish the layout for supports that shall be installed for suspension of ceilings. Installer shall furnish hanger clips, wire hangers, or similar devices for installation, in time to coordinate the work.

3.02 INSTALLATION

A. General: Install in accordance with manufacturer's instructions. Comply with applicable regulations and industrial standards.

B. Perimeters: Using a leveling or angle device, lay out and install perimeter trim, as specified.

C. Suspensions: Install suspension systems to comply with appropriate industry standards. Locate cliprails perpendicular to wood direction, 4 inches from one wall or structure for the first cliprail, continuing 24 inches maximum, on center, ending within 4 inches of the opposite wall or structure. #12-gauge wire hangers shall be installed 4 feet on center, along each cliprail. The wire hangers shall be attached to inserts, screw eyes, or other connecting devices that are secure and appropriate for suspending the ceiling; and that will not deteriorate or fail with age or elevated temperature.

D. Wood Strip Installation: Use manufacturer's standard clamping tool to snap wood strips onto cliprails. The clips, which are attached to the cliprail, have projections that insert into grooves cut into the back side of the wood strips. Proper tool adjustment is important to assure that the clips achieve a deep seat within the wood grooves. Installation shall proceed, in sequence, from one wall or structure to the opposite side. Hang wood strips with felt edge facing the area yet to be filled.

E. Edge Trims: Install edge trims with finish nails at all edges of the ceiling.

F. Electrical and mechanical installations must be supported independently of the linear wood ceiling.

G. Any deficiencies in the installed ceiling shall be corrected by installer at no additional cost to the Owner.

3.03 ADJUSTING

A. Make final adjustments to level or contours.

3.04 CLEANING

A. Upon completion of ceiling installation, all linear wood strips shall be cleaned free of dirt, dust, grease, oil, and fingerprints. Wood strip shall be wiped with furniture polish to enhance the surface finish.

B. All work that cannot be successfully cleaned or repaired shall be removed and replaced at no additional cost to the Owner.

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END OF SECTION

SECTION 09650

RESILIENT FLOORING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Resilient tile flooring.

B. Resilient base at all areas scheduled.

C. Installation accessories.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 01734 - Indoor Air Quality

D. Section 03300 - Cast in Place Concrete: Concrete substrate for work of this section.

E. Section 09680 - Carpet: Resilient base as scheduled.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns, colors available, and VOC data of adhesives; and installation instructions.

C. Shop Drawings: Indicate custom patterns and shapes as shown on Architect's samples. Indicate colors on shop drawings.

D. Initial Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

F. LEED Report: Report recycled content and VOC emission of flooring; VOC content of adhesives.
   1. For linoleum flooring, report rapidly-renewable content and urea-formaldehyde content.

1.05 ENVIRONMENTAL AND QUALITY ASSURANCE

A. Manufacturer: Provide each type of resilient flooring and accessories as produced by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds. All products shall have low VOC's.

B. Installer"s Qualifications: Engage Installer who is certified in writing by resilient flooring manufacturer as qualified for installation.

C. Do not provide materials containing bactericides and fungicides that are classified as phenol mercury acetates, phenol phenates, or phenol formaldehyde.

D. Do not provide products containing aromatic and aliphatic solvents.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Store all materials in accordance with manufacture's instructions.

B. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

C. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

D. Install resilient flooring and accessories after other finishing operations, including painting, have been completed. Do not install resilient flooring over concrete slabs until the latter have been cured and are sufficiently dry to achieve bond with adhesive as determined by resilient flooring manufacturer's recommended bond and moisture test and inspection.

1.07 EXTRA MATERIALS

A. See Section 01600 - Product Requirements, for additional provisions.

B. Deliver stock of maintenance materials to Owner. Furnish maintenance materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identifying labels.
   1. 12" X 12" Tile Flooring: Furnish not less than five percent for each type, color and pattern installed.
   2. Provide not less than five percent in base material for each variety installed.

PART 2 PRODUCTS

2.01 MATERIALS - TILE FLOORING

A. Linoleum Tile: Homogeneous wear layer bonded to backing, with color and pattern through wear layer thickness:
   1. Minimum Requirements: Comply with ASTM F 2195, Type corresponding to type specified.
   2. Backing: Synthetic fabric.
   3. Wear Layer Thickness: 0.098 inch, minimum, excluding backing.
   4. Tile Size: 13 x 13 inches.
   5. Pattern: Solid color.
   6. Color: Forbo's Veneto 6630 or approved equal.
   7. Manufacturers:
      a. Forbo Linoleum, Inc: www.forbo-industries.com.
      b. Tarkett Inc: www.tarkett.com.
      c. Eco Friendly Flooring: www.ecofriendlyflooring.com.
      d. Substitutions: See Section 01600 - Product Requirements.

2.02 MATERIALS - BASE

A. Resilient Base: ASTM F 1861, Rubber or vinyl cove base containing either minimum 10 percent natural rubber or minimum 10% recycled content; top set. Style A, Straight for use with carpet and linoleum, and as follows:
   1. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
   2. Height: 4 inch.
   3. Thickness: 0.125 inch thick.
   4. Finish: Matte.
   5. Length: Roll.
   6. Color: Roppe's P189 Walnut or approved equal.
   7. Accessories: Premolded external corners, internal corners, and end stops.

8. Manufacturers:
   a. Flexco Company; Product EnviroFlex: www.flexcofloors.com.
   b. Greenfloors; Product Recycled Cove Wall Base: www.greenfloors.com.
   c. Roppe Corp: www.roppe.com.
   d. Nora: www.norarubber.com
   e. Substitutions: See Section 01600 - Product Requirements.

2.03 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

B. Primers and Adhesives: Waterproof; types as recommended by flooring manufacturer.
   1. Solvent-free, VOC levels shall not exceed 50g/liter.

C. Resilient edge strips shall be used in locations shown on the drawings or where otherwise required to protect edges of resilient flooring. Install resilient edge strips securely with recommended low VOC adhesive to achieve a tightly butted joint.

D. Filler for Coved Base: Plastic.

E. Sealer and Wax: As recommended by flooring manufacturer. No coatings are to be used for Stratica; the no-polish properties are a permanent feature of Stratica.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive resilient flooring.

B. Verify that wall surfaces are smooth and flat within tolerances specified in Sections, are dust-free, and are ready to receive resilient base.

C. Verify that sub-floor surfaces are dust-free and free of substances which would impair bonding of adhesive materials to sub-floor surfaces.

D. Verify that concrete sub-floor surfaces are ready for resilient flooring installation by testing for moisture emission rate and alkalinity in accordance with ASTM F 710 and manufacturer's instructions; obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer. Do not install resilient tile until substrate has been approved by manufacturer.

E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler per flooring manufacturer's instructions to achieve smooth, flat, hard surface.

B. Prohibit traffic until filler is cured.

C. Clean substrate.

D. Apply primer as required according to flooring manufacturer's instructions to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - TILE FLOORING

A. Install in accordance with manufacturer's instructions.

B. Mix tile from container to ensure shade variations are consistent when tile is placed.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Set flooring in place, press with heavy roller to attain full adhesion.

E. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern and as shown on the drawings.

F. Lay out custom feature patterns along centerline of spaces and as shown on the drawings. Field tiles shall be placed symmetrically about feature patterns.

G. Install tile to basket weave pattern. Allow minimum 1/2 full size tile width at room or area perimeter.

H. Where floor finishes are different on opposite sides of door, terminate flooring under centerline of door.

I. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

J. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION- BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 48 inches between joints.

B. Installer shall use maximum lengths available to minimize joints and shall install preformed or molded corner units at all 90 degree intersections and exposed ends.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

3.05 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean surfaces with a neutral, low VOC cleaner as recommended by the Manufacturer.

3.06 PROTECTION OF FINISHED WORK

A. Prohibit traffic on resilient flooring for 48 hours after installation.

B. Protect flooring against damage during construction period to comply with resilient flooring manufacturer"s directions.

C. Apply protective floor polish to resilient flooring surfaces free from soil, excess adhesive or surface blemishes. Use commercial available metal cross-linked acrylic product acceptable to resilient flooring manufacturer.

D. Protect resilient flooring against damage from rolling loads for initial period following installation by covering with plywood or hardboard. Use dollies to move stationary equipment or furnishings across floors.

E. Cover resilient flooring with undyed, untreated building paper until final inspection.

3.07 WASTE MANAGEMENT

A. Separate waste in accordance with Sections 01355 and 01732 and the Waste Management Plan and place in designated areas in the following categories for reuse:
   1. Tiles larger than 1/2 tiles.

B. Linoleum and cork are biodegradable and may be shredded and composted.

C. Close and seal tightly all partly used adhesive containers and store protected in well ventilated, fire-safe area at moderate temperature.

END OF SECTION

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SECTION 09685

CARPET TILE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

1.02 RELATED SECTIONS

A. Section 01732 - Waste Management: Reclamation/Recycling of new carpet tile scrap

B. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

C. Section 03300 - Cast in Place Concrete

D. Section 04810 - Unit Masonry Assemblies

E. Section 09650 - Resilient Flooring: Resilient base at carpeted area.

1.03 REFERENCES

A. CRI (GLC) - Green Label Testing Program - Approved Product Categories for Carpet; www.carpet-rug.org; current edition.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

D. LEED Report: Submit data documenting VOC content of carpet tile and adhesives; copy of current CRI Approved Products Listing is acceptable. Submit for recycled contents and locally harvested and manufactured material and products.

E. Manufacturer's Installation Instructions: Indicate special procedures.

F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

1.07 EXTRA MATERIALS

A. See Section 01600 - Product Requirements, for additional provisions.

B. Provide 5% of carpet tiles of each color and pattern selected.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Interface Flooring Systems; Product Frequenc 2817 Iteration or approved equal.

B. Other Acceptable Manufacturers:
   1. C & A Floorcoverings, Inc/Tandus: www.cafloorcoverings.com.
   2. Lees Carpets: www.leescarpets.com.
   3. Milliken & Company: www.milliken.com.
   4. Substitutions: See Section 01600 - Product Requirements.

2.02 MATERIALS

A. Carpet Tile: Tufted, manufactured in one color dye lot.
   1. Tile Size: 20x20 inch, nominal.
   2. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E 648 or NFPA 253.
   3. Surface Flammability Ignition: Pass ASTM D 2859 (the "pill test").
   4. VOC Content: Provide CRI Green Label certified product; in lieu of labeling, independent test report showing compliance is acceptable.
   5. Pile Weight: 20 oz/sq yd.
   6. Primary Backing Material: Polypropylene.
   7. Recycled Content:
      a. Nylon Yarn: 80% min.
      b. Total Carpet Tile Unit: 22% min.
   8. Additional Treatment: Anti-bacterial treatment

2.03 ACCESSORIES

A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.

B. Edge Strips: Embossed aluminum, color as selected.

C. Adhesives: Acceptable to carpet manufacturers, compatible with materials being adhered; maximum VOC of 50 g/L; CRI Green Label certified; in lieu of labeled product, independent test report showing compliance is acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that sub-floor surfaces are dust-free and free of substances which would impair bonding of adhesive materials to sub-floor surfaces.

C. Verify that concrete sub-floor surfaces are ready for carpet tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by carpet tile manufacturer and adhesive materials manufacturer.

D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.

B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

C. Vacuum clean substrate.

3.03 INSTALLATION

A. Install carpet tile in accordance with manufacturer's instructions and CRI 104.

B. Blend carpet from different cartons to ensure minimal variation in color match.

C. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

D. Lay carpet tile in square pattern, with pile direction alternating to next unit, set parallel to building lines.

E. Fully adhere carpet tile to substrate.

F. Trim carpet tile neatly at walls and around interruptions.

G. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09900

PAINTS AND COATINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints, stains, varnishes, and other coatings.

C. See Schedule - Surfaces to be Finished, at end of Section.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Low VOC Paints and Coatings. Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 01734 - Indoor Air Quality: Low VOC Paints and Coatings

D. Section 04810 - Unit Masonry Assemblies

E. Section 05120 - Structural Steel

F. Section 05500 - Metal Fabrications: Shop-primed items.

G. Section 08110 - Steel Doors and Frames

H. Section 08310 - Access Doors and Panels

I. Section 09260 - Gypsum Board Assemblies

1.04 REFERENCES

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

B. ASTM D 16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2003.

C. ASTM D 4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 1992 (Reapproved 2003).

D. SSPC (PM1) - Good Painting Practice: SSPC Painting Manual, Vol. 1; Society for Protective Coatings; Fourth Edition.

E. USGBC LEED-NC - LEED Green Building Rating System for New Construction and Major Renovations, Version 2.2; U.S. Green Building Council; 2005.

1.05 DEFINITIONS

A. Conform to ASTM D 16 for interpretation of terms used in this section.

1.06 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on all finishing products, including VOC content.

C. Samples: Submit two paper chip samples, 3x5 inch in size illustrating range of colors available for each surface finishing product scheduled.

D. Samples: Submit two painted samples, illustrating selected colors for each color and system selected with specified coats cascaded. Submit on aluminum sheet, 6x6 inch in size.

E. LEED Report: VOC content of all interior opaque and transparent coatings actually used.

F. Manufacturer's Instructions: Indicate special surface preparation procedures.

G. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section approved by manufacturer.

1.08 INDOOR AIR QUALITY

A. Removing or reducing odor does not necessarily reduce toxins, and may only serve to reduce natural warning systems to toxins.

1.09 REGULATORY REQUIREMENTS

A. Conform to applicable code for flame and smoke rating requirements for products and finishes.

1.10 DELIVERY, STORAGE, AND PROTECTION

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

D. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

1.12 EXTRA MATERIALS

A. See Section 01600 - Product Requirements, for additional provisions.

B. Supply 1 gallon of each color; store where directed.

C. Label each container with color and room locations in addition to the manufacturer's label.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Design Basis: Sherwin Williams Co. Product: Harmony: www.sherwinwilliams.com

B. Other acceptable manufacturer:
   1. Benjamin Moore & Co.: www.benjaminmoore.com
   2. ICI Paints North America: www.icidecorativepaints.com
   3. Substitutions: See Section 01600 - Product Requirements.

2.02 PAINTS AND COATINGS - GENERAL

A. Paints and Coatings: Ready mixed, except field-catalyzed coatings. Prepare pigments:
   1. To a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
   2. For good flow and brushing properties.
   3. Capable of drying or curing free of streaks or sags.

B. Volatile Organic Compound (VOC) Content:
   1. Provide coatings that comply with the most stringent requirements specified in the following:
      a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
      b. USGBC LEED-NC Rating System, Version 2.2, EQ Credit 4.2; for interior wall and ceiling finish (all coats), anti-corrosive paints on interior ferrous metal, clear wood stains and finishes, sanding sealers, other sealers, shellac, and floor coatings.
         1) Opaque Topcoats, Flat: 10 g/L, maximum.
         2) Opaque Topcoats, Nonflat: 10 g/L, maximum.
   2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Chemical Content: The following compounds are prohibited:
   1. Aromatic Compounds: In excess of 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
   2. Acrolein, acrylonitrile, antimony, benzene, butyl benzyl phthalate, cadmium, di (2-ethylhexyl) phthalate, di-n-butyl phthalate, di-n-octyl phthalate, 1,2-dichlorobenzene, diethyl phthalate, dimethyl phthalate, ethylbenzene, formaldehyde, hexavalent chromium, isophorone, lead, mercury, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, naphthalene, toluene (methylbenzene), 1,1,1-trichloroethane, vinyl chloride.

D. Provide semi-gloss finish unless otherwise noted. Provide primer and two finish coats unless otherwise noted.

2.03 PAINT SYSTEMS - EXTERIOR

A. Paint ME-OP-2L - Ferrous Metals, Primed, Acrylic, 2 Coat:
   1. Touch-up with rust-inhibitive acrylic primer: Pro-Cryl Universal Primer B66-310 Series.
   2. Semi-gloss: Two coats of acrylic enamel; Sher-Cryl HPA B66-350 Series.

B. Paint MgE-OP-3A - Galvanized Metals, Acrylic, 3 Coat:
   1. One coat acrylic primer: Pro-Cryl Universal Primer B66-310 Series.
   2. Gloss: Two coats of acrylic enamel; Sher-Cryl HPA B66-350 Series.

2.04 PAINT SYSTEMS - INTERIOR

A. Paint WI-OP-3L - Wood, Opaque, Latex, 3 Coat:
   1. One coat of latex primer sealer: Harmony B11W900.

2. Semi-gloss: Two coats of latex enamel; Harmony B10 Series.
3. Eggshell: Two coats of latex enamel; Harmony B9 Series.
4. Flat: Two coats of latex enamel; Harmony B5 Series.

B. Paint WI-TR-V - Wood, Transparent, Varnish, No Stain:
1. Satin: Two coats of varnish; Polyurethane Acrylic Satin Varnish, VI-RAY 2 V-304.

C. Paint CI-OP-3L - Concrete/Masonry, Opaque, Latex, 3 Coat:
1. One coat of block filler: Heavy Duty Block Filler B42W46.
2. Latex primer: One coat; Harmony B11W900.
3. Semi-gloss: Two coats of latex enamel; Harmony B10 Series.

D. Paint MI-OP-3L - Ferrous Metals, Unprimed, Latex, 3 Coat:
1. One coat of acrylic primer: Pro-Cryl Universal Primer B66-310.
2. Semi-gloss: Two coats of latex enamel; Harmony B10 Series.

E. Paint MI-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
1. Touch-up with acrylic primer: Pro-Cryl Universal Primer B66-310 Series.
2. Semi-gloss: Two coats of latex enamel; Harmony B10 Series.

F. Paint MgI-OP-3L - Galvanized Metals, Latex, 3 Coat:
1. One coat acrylic primer: Pro-Cryl Universal Primer B66-310 Series.
2. Semi-gloss: Two coats of latex enamel; Harmony B 10 Series.

G. Paint GI-OP-3L - Gypsum Board, Latex, 3 Coat:
1. One coat of latex primer sealer: Harmony B11W900.
2. Semi-gloss: Two coats of latex enamel; Harmony B10 Series.
3. Eggshell: Two coats of latex enamel; Harmony B9 Series.
4. Flat: Two coats of latex enamel; Harmony B5 Series.

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified; commercial quality.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive Work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
1. Plaster and Gypsum Wallboard: 12 percent.
2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
3. Interior Wood: 15 percent, measured in accordance with ASTM D 4442.
4. Concrete Floors: 8 percent.

3.02 PREPARATION

A. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

B. Surfaces: Correct defects and clean surfaces which affect work of this section. Remove or repair existing coatings that exhibit surface defects.

C. Marks: Seal with shellac those which may bleed through surface finishes.

D. Impervious Surfaces: Remove mildew by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

E. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

F. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.

G. Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.

H. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

I. Interior Wood Items to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

J. Interior Wood Items to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

K. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 INDOOR AIR QUALITY

A. Applicators shall wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.

B. Maximize ventilation during application and drying.

C. Isolate area of application from rest of building.

D. Vacate space for as long as possible after application. Wait a minimum of 48 hours beforeoccupying freshly painted rooms.

3.04 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.

E. Sand wood and metal surfaces lightly between coats to achieve required finish.

F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

G. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

H. For exterior doors and frame, use interior paint for interior portion and exterior paint for exterior portion. Do not paint any interior elements with exterior paint.

3.05 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

A. Refer to Section 15190 for schedule of color coding of piping.

B. Paint shop-primed equipment, where indicated.

C. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

D. Finish equipment, piping, conduit, and exposed duct work in utility areas in colors according to the color coding scheme indicated in Divisions 15 and 16.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.06 FIELD QUALITY CONTROL

A. See Section 01400 - Quality Requirements, for general requirements for field inspection.

B. The Architect and Owner will conduct field inspection.

3.07 CLEANING

A. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.08 SCHEDULE - SURFACES TO BE FINISHED

A. Do Not Paint or Finish the Following Items:
   1. Items fully factory-finished unless specifically noted.
   2. Fire rating labels, equipment serial number and capacity labels.
   3. Stainless steel items.

B. Paint the surfaces described below under Schedule - Paint Systems.

C. Mechanical and Electrical: Use paint systems defined for the substrates to be finished.
   1. Paint all insulated and exposed pipes occurring in finished areas to match background surfaces, unless otherwise indicated.
   2. Paint shop-primed items occurring in finished areas.
   3. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
   4. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

D. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.

3.09 WASTE MANAGEMENT

A. Separate waste in accordance with Section 01355 and 01732 and the Waste Management Plan. Set aside extra paint for future color matches, or reuse by Owner, Habitat for Humanity, etc. Where paint recycling is available, collect all waste paint by type and provide for delivery to recycling or collection facility.

B. Close and seal tightly all partly used paint and finish containers and store protected in well-ventilated fire-safearea at moderate temperature.

C. Place empty containers of solvent based paints in areas designated for hazardous materials.

D. Do not dispose of paints or solvents by pouring on the ground. Place in designated containers for proper disposal.

3.10 SCHEDULE - PAINT SYSTEMS

A. Concrete Block: Finish all surfaces exposed to view.
   1. Interior: CI-OP-3L, semi-gloss.

B. Gypsum Board: Finish all surfaces exposed to view.
   1. Interior Ceilings and Bulkheads: GI-OP-3L, flat.
   2. Interior Walls: GI-OP-3L, semi-gloss.

C. Wood: Finish all surfaces exposed to view.
   1. Interior trim and frames: WI-OP-3L, semi-gloss.
   2. Interior timbers: WI-TR-V, satin.

D. Wood Cabinets: Finish all exposed and semi-exposed surfaces.
   1. Outside Surfaces: WI-TR-V, satin.

E. Steel Doors and Frames: Finish all surfaces exposed to view.
   1. Exterior Galvanized: MgE-OP-3A
   2. Interior Galvanized: MgI-OP-3L
   3. Interior No-Glavanized: MI-OP-2L

F. Steel Fabrications: Finish all surfaces exposed to view.
   1. Interior: MI-OP-3L, semi-gloss.

G. Shop-Primed Metal Items: Finish all surfaces exposed to view.
   1. Finish the following items:
      a. Exposed surfaces of lintels & pipe columns.
      b. Mechanical equipment.
      c. Electrical equipment.
      d. Other miscellaneous equipment as shown on the drawings.
   2. Exterior: ME-OP-2A
   3. Interior: MI-OP-2L

3.11 SCHEDULE - COLORS

A. General Walls, bulkheads and ceilings: Sherwin-Williams' 6386 Napery or approved equal.

B. Hollow Metal Door Frames: Sherwin-Williams' 2809 Rockwood Shutter Green or approved equal.

END OF SECTION

SECTION 10170

PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Floor mounted, overhead braced solid polymer resin plastic toilet compartments and urinal screens.

B. Doors matching compartment construction.

C. Associated heavy duty institutional hardware and accessories.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section-recycled content.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 04400 - Unit Masonry Assemblies

D. Section 09300 - Tile

E. Section 10800 - Toilet Accessories.

1.04 REFERENCES

A. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2003.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate partition plans, elevation views, dimensions, wall, floor, and ceiling supports, door swings, and details, including cut-out opening for toilet accessories, if any.

C. Product Data and selection samples: Provide data on panel construction, hardware, and accessories. Show compliance with recycled content requirements. Show choices of manufacturer's standard colors and finishes for selection by the Architect.

D. Verification Samples: Submit samples of partition panels, 12x12 inch in size illustrating panel finish, color, and sheen.

E. Manufacturer's Installation Instructions: Indicate special procedures.

F. LEED Report: Submit for recycled content and locally harvested and manufactured materials and products.

1.06 COORDINATION

A. Coordinate the work with placement of support framing and anchors in wall and ceiling.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Plastic Toilet Compartments:
   1. Santana Products Co., Inc; Product Poly-Mar HD, Poly-Marble HD & Poly-Granite HD: www.hinyhider.com.
   2. Ampco Products, Inc: www.ampco.com.
   3. Comtec Industries: www.comtecindustries.com.
   4. Eco Tec Partitions

2.02 COMPONENTS

A. Toilet Compartments: Solid molded polymer resin plastic panels, doors, and pilasters, floor-mounted headrail-braced. All panels shall have at least 20% post consumer recycled content.
   1. Color and finish: Single, uniform throughout, as selected from manufacturer's standard colors and finishes.
   2. All toilet partitions shall be secured with vandal resistant stainless steel machine screws with expansion anchors at masonry walls and toggle bolts at hollow walls and expansion anchors at other walls. Pilasters shall be secured to the floor with a minimum of two #13-1.5 in. stainless steel screws with expansion anchors.

B. Doors and Panels:
   1. Dimensions: As shown on the drawings.
   2. Thickness: 1 inch.
   3. Door Width: 24 inch minimum, as shown on drawing.
   4. Door Width for Handicapped Use: 36 inch minimum.
   5. Thickness of Pilasters: 1 inch.

C. Urinal Screens:
   1. Shall be of same construction as partitions.
   2. Shall be attached to wall and pilaster anchored to floor and overhead bracing, as shown on the drawings.

2.03 ACCESSORIES

A. Pilaster Shoes: Formed ASTM A 666, Type 304 stainless steel with No. 4 finish 4 inches high, with concealed floor fasteners.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

B. Head Rails: Hollow stainless steel tube, 1 x 1-5/8 inch minimum size, with anti-grip strips and cast socket wall brackets.

C. Pilaster Brackets: Satin stainless steel.

D. Wall Brackets: Continuous type, polished stainless steel.

E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
   1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.

F. Hardware and Fittings:
   1. Shall be heavy duty extruded aluminum construction with bright finish. Door hinges shall be integral and self closing at all locations. Provide continuous wall brackets at all installations. Provide "through bolts" (threaded insert with vandal resistant bolt at both sides) to secure hinges, brackets, stops, and latches to doors and partitions. Provide vinyl bumper strips to absorb impact at all doorstops and latches.
   2. Full Length Hinges: gravity type, adjustable for door close positioning.
   3. Door Latch: Slide type;
   4. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.

5. Coat hook with rubber bumper; one per compartment, mounted on door.
6. Provide door pull for outswinging doors.
7. Handicapped accessible toilet stalls shall be equipped with hardware that complies with North Carolina Accessibility Code 11.4.4.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify correct spacing of and between plumbing fixtures.

C. Verify correct location of built-in framing, anchorage, and bracing.

D. Coordinate with installation location of toilet accessories.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Attach panel brackets securely to walls using anchor devices specified above.

C. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

D. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 ERECTION TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.

B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.

B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.

C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10210

WALL LOUVERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Louvers, frames, and accessories.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 04810 - Unit Masonry Assemblies: Preparing exterior wall opening.

D. Section 07240 - Exterior Insulation and Finish System:

E. Section 07900 - Joint Sealers.

F. Section 15810 - Ducts: Ductwork attachment to louvers.

1.04 REFERENCES

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2005.

B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; Air Movement and Control Association International, Inc.; 1999.

C. AMCA 511 - Certified Ratings Program for Air Control Devices; Air Movement and Control Association International, Inc.; 1999(Rev 2004).

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.

C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.

D. Samples: Submit two samples 2 by 2 inches in size illustrating finish and color of exterior and interior surfaces.

E. Test Reports: Independent agency reports showing compliance with specified performance criteria.

F. LEED Report: Submit for recycled contents and locally harvested and manufactured materials and products.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type

specified in this section, with minimum three years of documented experience.

1.07 PROJECT CONDITIONS

A. Coordinate work of this section with installation of masonry flashing and E.I.F.S..

B. Coordinate work of this section with installation of mechanical ductwork.

1.08 WARRANTY

A. See Section 01780 - Closeout Submittals, for additional warranty requirements.

B. Provide twenty year manufacturer warranty against distortion, metal degradation, and failure of connections.
   1. Finish: Include coverage against degradation of exterior finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wall Louvers:
   1. The Airolite Company: www.airolite.com.
   2. Construction Specialties, Inc: www.c-sgroup.com.
   3. Ruskin Co..
   4. Substitutions: See Section 01600 - Product Requirements.

2.02 LOUVERS

A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified under AMCA 511.
   1. Wind Load Resistance: Design to resist positive and negative wind load of 25 psf without damage or permanent deformation.
   2. Intake Louvers: Design to allow maximum of 0.01 oz/sq ft water penetration at calculated intake design velocity based on design air flow and actual free area, when tested in accordance with AMCA 500-L.
   3. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
   4. Screens: Provide insect screens and bird screens.

B. Stationary Louvers: Horizontal blade, extruded aluminum construction, with intermediate mullions matching frame.
   1. Free Area: 50 percent, minimum.
   2. Blades: Inverted Y.
   3. Frame: 4 inches deep, channel profile; corner joints mitered and mechanically fastened, with continuous recessed caulking channel each side.
   4. Metal Thickness: Frame 0.081 inch; blades 0.081 inch.
   5. Finish: Polyvinylidene fluoride coating; finish welded units after fabrication.
   6. Color: To match storefront and exterior door frame color as scheduled.

2.03 MATERIALS

A. Extruded Aluminum: ASTM B 221 (ASTM B 221M),.

B. Bird Screen: Interwoven wire mesh of aluminum, 0.063 inch diameter wire, 1/2 inch open weave, diagonal design.

C. Insect Screen: 18 x 16 size aluminum mesh.

D. Polyvinylidene Fluoride Coating: Minimum 70 percent Kynar 500/Hylar 500 resin, two coat finish, complying with AAMA 2604.

E. Primer: Zinc chromate, alkyd type.

2.04 ACCESSORIES

A. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame.

B. Fasteners and Anchors: Stainless steel.

C. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.

D. Sealant: JS12 type, as specified in Section 07900.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared openings and flashings are ready to receive work and opening dimensions are as indicated on shop drawings.

B. Verify that field measurements are as indicated.

3.02 INSTALLATION

A. Install louver assembly in accordance with manufacturer's instructions.

B. Install louvers level and plumb.

C. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.

D. Secure louver frames in openings with concealed fasteners.

E. Install perimeter sealant and backing rod in accordance with Section 07900.

3.03 CLEANING

A. Strip protective finish coverings.

B. Clean surfaces and components.

3.04 SCHEDULES

A. As indicated on Drawings.

END OF SECTION

SECTION 10305

MANUFACTURED FIREPLACES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured direct-vent gas log steel box fireplace.

B. Accessories,including spark arrestor screen and fireplace tools.

C. Insulated direct-vent flue and associated wall flashings.

1.02 RELATED SECTIONS

A. Section 04810 - Unit Masonry Assemblies: Masonry enclosure and wall cladding surrounding fireplace box.

B. Section 15145 - Plumbing Piping: Gas piping to fire box.

1.03 REFERENCES

A. UL 127 - Standard for Factory-Built Fireplaces; Underwriters Laboratories Inc.; 1996.

1.04 DESIGN REQUIREMENTS

A. Fuel: Propane specified in Section 15145.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide fire box cabinet dimensions, clearances required from adjacent dissimilar construction, applicable regulatory agency approvalselectrical characteristics of fan and .

C. Shop Drawings: Indicate fire box rough opening dimensions, rough opening sizesfor chimney flue, fan size.

D. Manufacturer's Certificate: Certify that fireplace components meet or exceed UL requirements.

E. Manufacturer's Instructions: Indicate installation procedures and component installation sequence, clearances and tolerances from adjacent construction.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable code for clearances from adjacent materials, chimney height above roof line requirements, and unit UL approval.

B. Listed by Underwriters Laboratories Inc. as complying with UL 127.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufactured Fireplaces:
   1. Heat-N-Glo Fireplace Products, Inc; Product SL-950TR-D: www.heatnglo.com.
   2. Heatilator: www.heatilator.com.
   3. Quadra-Fire: www.quadrafire.com.
   4. Substitutions: See Section 01600 - Product Requirements.

2.02 Direct Vent Gas Fireplace

A. Sealed combustion direct vent fireplace.
   1. Sizes: 48-inch wide x 42-inch high.

2. Efficiency: Minimum AFUE of 70%.
3. Ignition: Electrical ignition to the pilot with a back-up battery, IntelliFire Ignition Systtem or equal.

2.03 ACCESSORIES

A. Circulating Fans: Motor and fan, UL approved, 120 volt, with remote on/off switch, sheet steel enclosure, and face grille.

B. Fasteners and Anchors: Galvanized steel type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared openings are ready to receive work and opening dimensions are as indicated on drawings.

B. Verify that proper power supply and fuel source are available.

3.02 INSTALLATION

A. Install unit assembly in accordance with manufacturer's instructions and UL requirements.

3.03 ERECTION TOLERANCES

A. Maximum Variation of Chimney From Plumb: 1/2 inch.

END OF SECTION

SECTION 10441

PLASTIC SIGNS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Raised letter plastic signs.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

1.04 REFERENCES

A. North Carolina State Building Code, Volume 1-C, Handicapped Accessibility: Section 4.11 "Signage and Identification".

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate sign styles, lettering font, foreground and background colors, locations, and overall dimensions of each sign. Include a fabrication schedule of all signage based on final room names and numbers approved by the owner. Obtain final schedule of room names and numbers from the Architect prior to submittal.

C. Samples: Submit two samples of each type of sign, illustrating type, style, letter font, available colors and method of attachment.

D. Manufacturer's Installation Instructions: Include installation template and attachment devices.

E. LEED Report: Submit for recycled content and loccally harvested and manufactured materials and products.

1.06 QUALITY ASSURANCE

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

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Package signs, labeled in name groups.

B. Store adhesive attachment tape at ambient room temperatures.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not install signs when ambient temperature is lower than recommended by manufacturer.

B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURER AND PRODUCT:

A. Signage shall be Series 850-16 by Andco: www.andco.com, or equal.

B. All signage shall comply with North Carolina Accessibility Code Chapter 18 "Signage and Identification" of the NC State Building Code for Accessibility and all applicable standards of the Americans With Disabilities Act.

2.02 OTHER MANUFACTURERS:

A. Other manufacturers which may be used, subject to compliance with product specifications, include:
   1. Best Sign Systems, Inc: www.bestsigns.com.
   2. Mohawk Sign Systems, Inc: www.mohawksign.com.

B. Substitutions: See Section 01600 - Product Requirements.

2.03 INTERIOR RAISED LETTER SIGNS

A. All interior signs shall be manufactured from 1/16 inch thick clear matte acrylic that is subsurface printed with a background color and laminated to a 1/16 inch opaque white or black acrylic base and has 1/16 inch raised acrylic letters.

B. Base Material: solid color matte acrylic plastic:
   1. Total Thickness: 1/8 inch.
   2. Height: As indicated on the drawing.
   3. Edges: Radiused
   4. Color: To be selected by Architect.

C. Raised Character Size and Style: Acrylic plastic, character adhered to base material:
   1. Comply with applicable provisions of ANSI/ICC A117.1, including Braille.
   2. Character Color: Black or White.
   3. Character Thickness: 1/16 inch.
   4. Height: Comply with North Carolina Accessibility Code 18.4.
   5. Edges: Square.
   6. Character Font: Helvetica.
   7. Character Case: Upper case only.

2.04 ACCESSORIES

A. Tape Adhesive: Double sided tape, permanent adhesive.

2.05 INTERPRETIVE SIGNS

A. Sustainable feature interpretive signs shall be printed on phenolic fused exterior rated panels.

B. One sign shall describe, including graphics provided by Architect, each of the following features:
   1. Overall Green Features, wall mounted
   2. Daylighting, wall mounted
   3. Energy Efficiency, wall mounted
   4. Water Conservation Fixtures, wall mounted
   5. Photovoltaics, free standing
   6. Solar Doemstic Hot Water, free standing
   7. Geothermal Heat Pumps, free standing
   8. Rainwater Catchment System, wall mounted
   9. Constructed Wetlands, free standing
   10. Sustainable Materials, wall mount

C. Each sign shall be 27 inches wide by 12 inches high.

D. Free standing signs shall be supoorted by aluminum welded and powder coated freestanding carrier. Color to be selected by Architect.

2.06

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings.

B. Position sign 4 inches from strike side of door, level.

C. Centerline of sign shall be 60 inches above finished floor or ground level.

D. Locations of interior raised letter signs shall be as indicated on drawings.

E. Locations of interpretive signs shall be coordinated with Architect.

3.03 SCHEDULE

A. Interior signs shall be required at all doors and spaces according to final room names and numbers approved by the owner. Obtain final owner approved schedule of room names and numbers from the Architect before submitting shop drawings and fabrication schedules. For bidding purposes, provide signage according to the room name as indicated on the drawings and as specified.

B. All signs shall include the applicable room name as well as pictograms required by North Carolina Accessbility Code Chapter 18.

C. Toilet Facilities shall receive signage Type B with the appropriate name (Men, Women or Family), room name, and pictogram as indicated on the drawing.

D. Room Door Signs: Type A, identifying room name, and layout as indicated on the drawing.

END OF SECTION

SECTION 10500

LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Locker units with hinged doors.

B. Metal bases, tops, and filler panels.

1.02 REFERENCES

A. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2004a.

1.03 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on locker types, sizes and accessories.

C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.

D. Samples: Submit two samples 3 x 6 inches in size, of each color scheduled; applied to specified base metal.

E. Manufacturer's Installation Instructions: Indicate component installation assembly.

F. LEED Report: Submit for recycled content and locally harvested and manufactured materials and products.

1.04 DELIVERY, STORAGE, AND PROTECTION

A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Lockers:
   1. Lyon Workspace Products: www.lyonworkspace.com.
   2. Penco Products, Inc: www.pencoproducts.com.
   3. Republic Storage Systems Co: www.republicstorage.com.
   4. Substitutions: See Section 01600 - Product Requirements.

2.02 MATERIALS

A. Sheet Steel: ASTM A 653/A 653M SS Grade 33/230, with G60/Z180 coating, stretcher leveled; to the following minimum thicknesses:
   1. Body and Shelf: 24 gage, 0.024 inch.
   2. Door Outer Face: 18 gage, 0.048 inch.
   3. Door Inner Face: 20 gage, 0.036 inch.
   4. Door Frame: 16 gage, 0.060 inch.
   5. Hinges: 14 gage, 0.075 inch.
   6. Base: 20 gage, 0.036 inch.
   7. Sloping Top: 20 gage, 0.036 inch.
   8. Trim: 20 gage, 0.036 inch.

B. Accessories For Each Locker: Two single prong wall hooks, rubber bumper.

2.03 LOCKER UNITS

A. Width: 12 inches.

B. Depth: 12 inches.

C. Height: 72 inches.

D. Configuration: double tier.

E. Base: Metal base.
   1. Base Height: 4 inch.

F. Locking: Equipped for built-in combination locks.

G. Ventilation Method: Door louvers.

H. Class: Conventional.

I. Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.

J. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.

K. Doors: Hollow double pan, sandwich construction, 1-3/16 inch thick; welded construction, channel reinforced top and bottom with intermediate stiffener ribs, grind and finish edges smooth.

L. Hinges: Two for doors under 42 inches high; three for doors over 42 inches high; weld securely to locker body and door.

M. Integral Cylinder Lock: combination type, master keyed; provide two keys per lock and four master keys.

N. Locking Device: Supply one master-keyed combination padlock for each locker not equipped with an integral cylinder lock.

O. Number Plates: Provide oval shaped brass plates. Form numbers 3/8 inch high of block font style, in contrasting color.

P. Finish edges smooth without burrs.

Q. Fabricate metal tops, ends and closure pieces.

R. Provide end panels and filler strips.

2.04 FINISHING

A. Clean, degrease, and neutralize metal; prime and finish with one coat of baked enamel.

B. Paint locker units 1 color, as selected.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared bases are in correct position and configuration.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install lockers plumb and square.

C. Place and secure on prepared base.

D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 lb.

E. Bolt adjoining locker units together to provide rigid installation.

F. Install end panels and filler panels.

G. Install accessories.

H. Replace components that do not operate smoothly.

3.03 CLEANING

A. Clean locker interiors and exterior surfaces.

3.04 SCHEDULES

A. Storage Room: Two (2) 12 inches wide, 12 inches deep, 72 inches high, double tier; 1 single coat hook, sloped metal top; placed on continuous 4 high metal base.

END OF SECTION

SECTION 10523

FIRE EXTINGUISHERS, CABINETS AND ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 04810 - Unit Masonry Assemblies: Roughed-in wall openings.

1.04 REFERENCES

A. NFPA 10 - Standard for Portable Fire Extinguishers; National Fire Protection Association; 2002.

B. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.05 PERFORMANCE REQUIREMENTS

A. Conform to NFPA 10.

B. Provide cabinets classified and labeled by Underwriters Laboratories Inc. for installation in rated partitions as identified on Drawings.

1.06 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate cabinet physical dimensions.

C. Product Data: Provide color and finish and anchorage details.

D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

E. LEED Report: Submit for recycled content and locally harvested and manufactured materials and products.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers, Cabinets and Accessories:
   1. JL Industries, Inc: www.jlindustries.com.
   2. Larsen's Manufacturing Co: www.larsensmfg.com.
   3. Potter-Roemer: www.potterroemer.com.
   4. Substitutions: See Section 01600 - Product Requirements.

2.02 FIRE EXTINGUISHERS

A. Water Type: Stainless steel tank, with granular soda for pressurization, including hose and nozzle.
   1. Class 2A.
   2. Size and classification to fit in the cabinet.
   3. Finish: Baked enamel, red color.

2.03 FIRE EXTINGUISHER CABINETS

A. Product: Similar and equal to Model 2012 Ambassador by J.L. Industries.

B. Metal: Formed primed steel sheet; 0.036 inch thick base metal.

C. Cabinet Configuration: Semi-recessed type.
   1. Exterior nominal dimensions of 12 inch wide x 27 inch high x 8 inch deep.
   2. Trim: Returned to wall surface, with 1/4 inch projection, 2 inch wide face.
   3. Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim and door stiles.

D. Door: 0.036 inch thick, reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with two butt hinge. Provide nylon catch.

E. Door Glazing: Breakable Scored Plastic, Clear, 1/8 inch thick acrylic. Set in resilient channel gasket glazing.

F. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.

G. Weld, fill, and grind components smooth.

H. Finish of Cabinet Exterior Trim and Door: Baked enamel, white color.

I. Finish of Cabinet Interior: White enamel.

2.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated, similar and equal to Model MB808 by J.L. Industries and sized for fire extinguisher to be supplied by owner.

B. Cabinet Signage: FIRE EXTINGUISHER in red letter.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install the top of fire extinguishers at maximum 54 inches high above finished floor.

B. Secure rigidly in place.

C. Place extinguishers and accessories in cabinets.

END OF SECTION

SECTION 10670

STORAGE SHELVING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Freestanding and Wall-mounted Metal Storage Shelving Systems shown on the drawings.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 04810 - Unit Masonry Assemblies.

D. Section 06100 - Rough Carpentry.

E. Section 09260 - Gypsum Board Assemblies.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's catalog data, detail sheets, and specifications.

C. Shop Drawings: Prepared specifically for this project; show dimensions of shelving and interface with other products.

D. LEED Report: Submit for recycled content and locally harvested and manufactured materials and products.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: E-Z Shelving, Inc.
   1. E-Z Shelving, Inc.: www.e-zshelving.com
   2. Hallowell: www.hallowell-list.com
   3. Penco: www.pencoproducts.com

B. Substitutions: See Section 01600 - Product Requirements.

C. Provide all storage shelving from a single manufacturer.

2.02 MANUFACTURED UNITS

A. Metal Shelving: 16 gauge, G-90, LFQ, ASTM A-527 galvanized sheet, with front and rear edges flanged in two directions for rigidity, depth as shown on details and as scheduled.

B. Metal Bracket and Hanger System:
   1. Wall mounted upright hanger: 14 gauge rolled steel channels, punched to receive mounting screws, length as required for specific use. See Drawings for locations and heights.
   2. Bracket: Single and double brackets as required for 36" maximum length shelving units. Single units for end and center conditions and double units for transitions between shelves.
      a. Depth as shown on details and as scheduled. Gauge set by design requirements.

2.03 DESIGN REQUIREMENTS

A. Shelf Loading Capacity and Bracket Spacing:
   1. 12 inch depth shelving: Load: 370psf Spacing: max. 3'-0" o.c.
   2. 18 inch depth shelving: Load: 200psf Spacing: max. 3'-0" o.c.
   3. 24 inch depth shelving: Load: 195psf Spacing: max. 2'-0" o.c.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:
   1. Verify that prepared spaces are sized and located in accordance with shop drawings.
   2. Verify that framing, reinforcement, and anchoring devices are correct type and are located in accordance with shop drawings.

B. Installer's Examination:
   1. Examine conditions under which installation is to be performed; submit written notification if such conditions are unacceptable.
   2. Installation activities before unacceptable conditions have been corrected is prohibited.
   3. Installation indicates installer's acceptance of conditions.

3.02 INSTALLATION

A. Install shelves to lengths as shown in Drawings. Grind exposed edges for smooth finish.

B. Install shelving plumb and level at heights indicated in accordance with shop drawings and manufacturer's printed installation instructions.

C. Use manufacturer's recommended attachment system for each substrate encountered.

3.03 CLEANING

A. As work proceeds, maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris related to this work.

B. Upon completion of installation, clean all surfaces that have become soiled during installation.

END OF SECTION

SECTION 10800

TOILET ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Accessories for toilet rooms and utility rooms.

B. Grab bars.

C. Stainless Steel and Stainless Steel Framed Mirrors.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 04810 - Unit Masonry Assemblies: Installation of accessaries on CMU wall.

D. Section 10170 - Plastic Toilet Compartments.

1.04 REFERENCES

A. ASTM A 269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2004.

B. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2003.

C. ASTM C 1036 - Standard Specification for Flat Glass; 2001.

D. GSA CID A-A-3002 - Mirrors, Glass; U.S. General Services Administration; 1996.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods for each wall type.

C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

1.06 COORDINATION

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, reinforcement of toilet partitions, and CMU rough opening to receive anchor attachments.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Products listed are made by Bradley Corporation: www.bradleycorp.com.

B. Other Acceptable Manufacturers:

1. American Specialties, Inc: www.americanspecialties.com.
2. Bobrick: www.bobrick.com.
3. Substitutions: Section 01600 - Product Requirements.

C. All items of each type to be made by the same manufacturer.

2.02 MATERIALS

A. Accessories- General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.

B. Keys: Provide 3 keys for each accessory to Owner.

C. Stainless Steel Sheet: ASTM A 666, Type 304.

D. Stainless Steel Tubing: ASTM A 269, Type 304 or 316.

E. Mirror Glass: Float glass, ASTM C 1036 Type I, Class 1, Quality Q2, with silvering, copper coating, and suitable protective organic coating to copper backing in accordance with GSA CID A-A-3002.

F. Fasteners, Screws, and Bolts: Stainless steel, tamper-proof, security type.

2.03 FINISHES

A. Stainless Steel: No. 4 satin brushed finish, unless otherwise noted.

2.04 TOILET ROOM ACCESSORIES

A. Toilet Paper Dispenser: Double jumbo roll, surface mounted bracket type, stainless steel.
   1. Product: Model 5425 manufactured by Bradley.

B. Combination Towel Dispenser/Waste Receptacle: Semi-recessed with projecting waste receptacle, stainless steel; seamless wall flanges, continuous piano hinges, tumbler locks on upper and lower doors.
   1. Waste receptacle liner: Reusable, heavy-duty vinyl.
   2. Towel dispenser capacity: 800 multi-fold.
   3. Waste receptacle capacity: 12 gallons.
   4. Product: Model 234-10 manufactured by Bradley.

C. Soap Dispenser: Liquid soap dispenser, wall-mounted, recessed, with stainless steel cover and horizontal stainless steel tank and working parts; push type soap valve, check valve, and window gage refill indicator, tumbler lock.
   1. Minimum Capacity: 32 ounces.
   2. Product: Model 643 manufactured by Bradley.

D. Mirrors: Stainless steel framed, 6 mm thick float glass mirror.
   1. Size: Room 103, 105, 106 & 108: 8 feet wide by 4 feet high; Room 005 & 109: 18 inches wide by 30 inches high.
   2. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; No.4 finish.
   3. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
   4. Fixed Tilt Mirrors: Minimum 3 inches tilt from top to bottom in Room 005 & 109.

E. Grab Bars: Stainless steel, 1-1/4 inches outside diameter, minimum 0.05 inch wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.
   1. Length and configuration: As indicated on drawings.

F. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
   1. Product: Model 4722-15 manufactured by Bradley at single compartments.
   2. Product: Model 4721-15 manufactured by Bradley at shared compartments.

G. Robe Hooks: Heavy-duty stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish, combination with door bumper.

2.05 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Model 9984, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
   1. Drying rod: Stainless steel, 1/4 inch diameter.
   2. Hooks: 2, 0.06 inch stainless steel rag hooks at shelf front.
   3. Mop/broom holders: 3 spring-loaded rubber cam holders at shelf front.
   4. Length: 36 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. Verify that field measurements are as indicated on drawings.

D. See Sections 06100 and 09260 for installation of blocking, reinforcing plates, and concealed anchors in walls for support of toilet accessories.

E. Verify rough opening sizes in CMU wall.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights and Locations: As required by accessibility regulations and as indicated on drawings

END OF SECTION

SECTION 11131

LCD SCREEN SUPPORT BRACKETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall mounted LCD screen support brackets and accessories as shown on the drawings.

1.02 RELATED SECTIONS

A. Section 05210 - Steel Joists: Attachment of television mounting brackets to structure above.

B. Section 092650 - Gypsum Board Assemblies

C. Section 09511 - Suspended Acoustical Ceilings

D. Division 16: Wiring of data cable and electric power through the bracket to the screen.

1.03 REFERENCES

A. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.

B. NFPA 70 - National Electrical Code; National Fire Protection Association; 1999.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's data sheet showing installation details and ability to support owner supplied television sets.

C. Manufacturer's Instructions: Indicate special installation instructions and mounting detail to structure above.

D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

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

B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

C. Design of bracket must withstand a 200 lb vertical load.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Deliver brackets to project site in factory packaging.

B. Store brackets under cover and elevated above grade.

1.07 WARRANTY

A. See Section 01780 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers:

1. Peerless
2. Bretford Mfg. Inc.
3. Wilson: H. Wilson Co.

2.02 WALL MOUNTED BRACKETS

A. Shall be similar and equal to Peerless Model #ST640. The General Contractor shall provide all required wall supports to mount the wall bracket sufficient to withstand a 200 lb. vertical load. The point of attachment shall be able to accept a 1-1/2" NPT extension pipe. Construction shall be of heavy gauge cold rolled steel, MIG welded for maximum strength and security, and finished with an black powder coated epoxy scratch resistant finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that structure is prepared to receive work of this section.

3.02 PREPARATION

A. Locate bracket drop in locations shown in Drawings. Coordinate with lay-in ceiling grid locations to avoid conflicts.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions. Provide support from structure above.

3.04 ERECTION TOLERANCES

A. Maximum Variation From True Position: 1/4 inch (6 mm).

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

3.05 CLEANING and PROTECTION

A. Clean brackets in accordance with Manufacturer's instructions.

B. Protect installed brackets from subsequent construction operations.

END OF SECTION

SECTION 11450

RESIDENTIAL EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Kitchen appliances.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Construction Waste Management: Application of work of this Section to the Waste Management Plan.

C. Division 16 - Electrical connections for appliances.

1.04 REFERENCES

A. UL (EAUED) - Electrical Appliance and Utilization Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.05 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.

C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

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

B. Electric Appliances: Listed and labeled by UL and complying with NEMA standards.

1.07 WARRANTY

A. See Section 01780 - Closeout Submittals, for additional warranty requirements.

B. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.

C. Provide ten (10) year manufacturer warranty on magnetron tube of microwave ovens.

PART 2 PRODUCTS

2.01 KITCHEN APPLIANCES

A. Refrigerator: Free-standing, top-mounted freezer, frost-free with EnergyStar Label.
   1. Capacity: Total minimum storage of 18 cubic ft; minimum 15 percent freezer capacity.
   2. Energy Usage: Minimum 20 percent more energy efficient than energy efficiency standards set by DOE. Refrigerator shall carry EnergyStar label.
   3. Features: Include glass shelves, automatic icemaker, and light in freezer compartment.
   4. Finish: Porcelain enameled steel, color white.

5. Manufacturers:
   a. Frigidaire Home Products: www.frigidaire.com.
   b. GE Appliances: www.geappliances.com.
   c. Whirlpool Corp: www.whirlpool.com.
   d. Substitutions: See Section 01600 - Product Requirements.

B. Modular Cooktop: Electric, with glass-ceramic cooktop.
1. Size: 24 inches.
2. Elements: 2.
3. Features: Include grille module and griddle module. Front control panel to meet ADA.
4. Finish: Porcelain enameled steel, color white.
5. Manufacturers:
   a. Frigidaire Home Products: www.frigidaire.com.
   b. GE Appliances: www.geappliances.com.
   c. Whirlpool Corp: www.whirlpool.com.

C. Cooking Exhaust:.
1. Size: 24 inches.
2. Fan: Single- speed, 250 cfm
3. Exhaust: Recirculating, recirculated.
4. Features: Include cooktop light and removable grease filter.
5. Finish: Painted steel, color as indicated.
6. Manufacturers:
   a. Frigidaire Home Products; Product ____: www.frigidaire.com.
   b. GE Appliances; Product ____: www.geappliances.com.
   c. Whirlpool Corp; Product ____: www.whirlpool.com.

D. Microwave: Countertop. Energy-Star labeled.
1. Capacity: 1.3 cubic ft.
2. Controls: Front controls for compliance with ADA Accessiility Code and North Carolina Volume 1-C Accessibility Code
3. Power: 700 watts.
4. Features: Include turntable.
5. Finish: White.
6. Manufacturers:
   a. Frigidaire Home Products: www.frigidaire.com.
   b. GE Appliances: www.geappliances.com.
   c. Whirlpool Corp: www.whirlpool.com.
   d. Substitutions: See Section 01600 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify utility rough-ins are present and correctly located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Anchor built-in equipment in place.

3.03 ADJUSTING

A. Adjust operating equipment to efficient operation.

3.04 CLEANING

A. Remove packing materials from equipment.

B. Wash and clean equipment.

END OF SECTION

SECTION 12486

FLOOR MATS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to work of this Section.

1.02 SECTION INCLUDES

A. Recycled rubber tread mat.

B. Recessed frame.

1.03 RELATED SECTIONS

A. Section 01355 - LEED Requirements: Submittal requirements for products of this Section.

B. Section 01732 - Construction Waste Management: Application of work of this Section to the Waste Management Plan.

C. Section 03300 - Cast In Place Concrete: Recessed areas for floor mats as shown on the drawings.

1.04 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating properties of mat, component dimensions and recessed frame characteristics.

C. Shop Drawings: Indicate dimensions and details for recessed frame.

D. Samples: Submit two samples, 12x12 inch in size illustrating pattern, color, finish, edging.

E. Maintenance Data: Include cleaning instructions, stain removal procedures.

F. LEED Report: Submit for recycled contents and locally harvested and manufactured materials and products.

1.05 PROJECT CONDITIONS

A. Verify that field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Floor Mats:
   1. Arden Architectural Specialties; Product: EnviRonTread M-775 with F-9 Frame; www.ardenarch.com
   2. American Floor Products Company, Inc: www.afco-usa.com.
   3. J L Industries: www.jlindustries.com.
   4. Substitutions: See Section 01600 - Product Requirements.

2.02 MATERIALS

A. Mat: LDPE hinged roll-up mat with 1/2" deep 6063-T52 aluminum alloy rails spaced 2" o.c.; with low-density polyethylene hinges, with two buffed recycled rubber tread per rail. Provide 5/8" thick extruded aluminum alloy recessed frame..

2.03 FABRICATION

A. Construct recessed mat frames square, tight joints at corners, rigid. Coat surfaces with protective coating where in contact with cementitious materials.

B. Fabricate mats in single unit sizes; fabricate multiple mats where indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor opening for mats are ready to receive work.

3.02 PREPARATION

A. Verify size of floor recess before fabricating mats.

B. Vacuum clean floor recess.

3.03 INSTALLATION

A. Install mat frames to achieve flush plane with finished floor surface.

B. Install mats in floor recess flush with finish floor after cleaning of finish flooring.

3.04 INSTALLATION TOLERANCES

A. Maximum Gap Formed at Recessed Frame From Mat Size: 1/4 inch.

END OF SECTION

SECTION 13851

FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes fire alarm systems.

B. Definitions:

1. FACU: Fire Alarm Control Unit
2. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

C. System Description:

1. Fire alarm system shall be addressable type, with a 24Vdc nominal operating voltage. All equipment supplied must be specifically listed for its intended use and shall be installed in accordance with any instructions included in its listing. The contractor shall furnish all parts, materials, and labor customarily required or provided for a complete and operating system, in accordance with all requirements applicable, even if each needed item is not specifically shown or described in the project plans or specifications.

2. **Note: This specification has incorporated the guidelines given by the DOI document, "Fire Detection and Alarm Systems" dated July, 25, 2005. As stated in these guidelines, Method 3 has been used and all relevant criteria contained in the referenced DOI document have been incorporated in this specification.**

D. Performance Requirements:

1. Comply with NFPA 72 and Authority Having Jurisdiction (AHJ).

2. For State Owned facilities in North Carolina, the AHJ is the NC Department of Insurance-Office of State Fire Marshal. A free copy of Fire Detection and Alarm Systems published by NCDoI is available at their office and the contractor must familiarize with the latest requirement at the time of bidding.

3. Fire alarm signal initiation shall be by one or more of the following devices:

a. Manual stations.
b. Heat detectors.
c. Smoke detectors.
d. Verified automatic alarm operation of smoke detectors.

4. Fire alarm signal shall initiate the following actions:

a. Alarm notification appliances shall operate continuously.
b. Identify alarm at the FACU.
c. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
d. Close smoke dampers in air ducts of system serving zone where alarm was initiated.

e. Record events in the system memory.

5. System trouble signal initiation shall be by one or more of the following devices or actions:

a. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
b. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.
c. Loss of primary power at the FACU.
d. Ground or a single break in FACU internal circuits.
e. Abnormal ac voltage at the FACU.
f. A break in standby battery circuitry.
g. Failure of battery charging.
h. Abnormal position of any switch at the FACU.

6. System Trouble and Supervisory Signal Actions: Ring trouble bell and annunciate at the FACU. Record event.

1.2 SUBMITTALS

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

B. Shop Drawings:

1. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
2. Device Address List: Coordinate with final system programming.
3. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
4. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.

5. Batteries: Size calculations. Use manufacturer's battery discharge curve to determine expected battery voltage after 24 hours of providing standby power. Then use calculated Notification Appliance Circuit current draw in the alarm mode to determine expected voltage drop at EOL, based on conductor resistance per manufacturer's data sheet or per NEC. Double the ohms per foot since two conductors are required to power the circuit. Also, add any voltage drop caused by the system's power supply. The voltage drop at EOL must not exceed 14% of the expected battery voltage, after the required standby time plus alarm time. Typically, for a 24V system, this limits the voltage drop from the battery to the EOL to 3 volts. Determine worst case voltage at far end of each NAC, by subtracting its calculated V-drop from the expected battery voltage. All these calculations must be placed on a dedicated sheet of as-built drawings, for future reference by fire alarm service technician. NAC voltage drop is to be verified during system tests.

C. Field quality-control test reports.

D. Operation and maintenance data.

E. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Engineer for review.

F. Documentation, Owner training and Spare Parts:

a. In addition to shop drawings, the fire alarm contractor shall provide the Engineer two bound copies of the following technical information, for transmittal to the Owner: 1) As built wiring diagram showing all loop numbers and device addresses, plus terminal numbers where they connect to control equipment, 2) Manufacturer's detailed maintenance requirements, 3) Technical literature on all control equipment, isolation modules, power supplies, alarm/supervisory signal initiating devices, alarm notification appliances, relays, etc. 4) The as-built calculations sheet as described in other section of this specifications.

b. Complete configuration data (site specific programming) for the system must be stored in electronic media and archived by the fire alarm system manufacturer or authorized distributor. A CD copy of this data shall be submitted to the Engineer for transmission to the Owner on the day the system is commissioned.

c. The manufacturer, or authorized distributor, must maintain software version (VER) records on the system installed. The system software shall be upgraded free of charge if a new VER is released during the warranty period. For new VER to correct operating problems, free upgrade shall apply during the entire life of the system.

d. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

e. Provide engraved label inside FACU identifying 120V ac power source, as follows: panelboard location, panelboard identification, and branch circuit number.

f. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. A minimum of 2 hours on-site will be allocated for this purpose. Two copies of a written bound summary will be provided for future reference.

g. The following spare parts shall be provided with the system.
Fuses – 2 of each size
Manual Fire Alarm boxes – 2% of installed quantity
Addressable control relay – 4% of installed quantity
Indoor Horn/strobes - 4% of installed quantity
Monitor modules - 4% of installed quantity
Isolation modules/base - 4% of installed quantity
Addressable heat detectors- 6% of installed quantity
Spot-type smoke detectors - 6% of installed quantity

1.3 QUALITY ASSURANCE

A. Installer Qualifications: The manufacturer's authorized representative that terminates the FACU and performs all tests and inspections shall be NICET Level 2 certified and have at least two years of experience installing fire alarm systems. Furthermore, the manufacturer's authorized distributor must have at least one employee with a NICET Level 3 certification and must be trained and certified by manufacturer for installation of units required for this Project. The training and certification must have occurred within the most recent 24 months. Copies of the certification must be part of contractor's submittal to Engineer, prior to installation.

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.

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:

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

1. FACU and Equipment:

a. Edwards Systems Technology Inc.
b. Fire Control Instruments, Inc.; a GE-Honeywell Company.
c. Notifier; a GE-Honeywell Company.

2. Wire and Cable:

a. Comtran Corporation.
b. Helix/HiTemp Cables, Inc.; a Draka USA Company.
c. Rockbestos-Suprenant Cable Corporation; a Marmon Group Company.
d. West Penn Wire/CDT; a division of Cable Design Technologies.

3. Audible and Visual Signals:

a. Amseco; a division of Kobishi America, Inc.
b. Commercial Products Group.
c. Gentex Corporation.
d. System Sensor; a GE-Honeywell Company.

2.2 FACU

A. General Description:

1. Modular, power-limited design with electronic modules, UL 864 listed.
2. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, two line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. Circuits:

1. Signaling Line Circuits: NFPA 72, Class A, Style 6 with no "T" taps. Each must have 20% spare addresses for future use.

a. To minimize wiring fault impact, isolation modules shall be provided as follows.
b. Immediately adjacent to the FACU, at each end of the addressable loop. These two isolators must be in the same room as the FACU and within 15'.
c. After each 25 initiating devices and control points on the addressable loop or a lesser number where recommended by manufacturer.
d. For loops covering more than one floor, install isolator at terminal cabinet on each floor.
e. Each isolator module shall be clearly labeled, readily accessible for convenient inspection (not above ceiling) and shown on as built drawing.
f. There shall not be any splices in the system other than at device terminal blocks, or on terminal blocks in cabinets.

2. Actuation of alarm notification appliances shall occur within 10 seconds after the activation of an initiating device.

3. Electrical monitoring for the integrity of wiring external to the FACU for mechanical equipment shutdown and magnetic door-holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shut down.

4. Alarm Notification Appliance circuits shall be NFPA 72 Style Y (Class B). The load connected to each circuit must not exceed 80% of rated module output.

D. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm verification" signal at the FACU.
2. Activate a listed and approved "alarm verification" sequence at the FACU and the detector.
3. Record events.
4. Sound general alarm if the alarm is verified.
5. Cancel FACU indication and system reset if the alarm is not verified.

E. Notification-Appliance Circuit: Operation shall sound in three temporal pattern, complying with ANSI S3.41.

F. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.

G. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACU after initiating devices are restored to normal.

1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.

H. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACU shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.

I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, supervisory and digital alarm communicator shall be powered by the 24-V dc source.

1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.
2. Power supply shall have a dedicated fused safety switch for this connection at the service entrance equipment. Paint the switch box red and identify it with "FIRE ALARM SYSTEM POWER."

J. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.

1. Batteries: Vented, wet-cell pocket, plate nickel cadmium.
2. Battery and Charger Capacity: Minimum 24 hours secondary power capacity, plus 5 minutes of full alarm load.

K. Surge Protection:

1. Install surge protection on normal ac power for the FACU and on Fire Alarm initiating and notification circuits as shown on riser diagram.

2.3 MANUAL FIRE ALARM BOXES

A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACU.
2. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACU.
3. Station Reset: Key- or wrench-operated switch.

2.4 SYSTEM SMOKE DETECTORS

A. General Description:

1. UL 268 listed, operating at 24-V dc, nominal.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACU.

3. Multipurpose type, containing the following:

   a. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACU.
   b. Piezoelectric sounder rated at 88 dBA at 10 feet according to UL 464.
   c. Heat sensor, combination rate-of-rise and fixed temperature.

4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.

5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.

7. All addressable spot type and duct detectors shall be the analog type and the alarm system shall automatically compensate for detector sensitivity changes due to ambient conditions and dust build-up within detectors. This feature must be armed and sensitivities set prior to acceptance of system.

B. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.
2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

C. Duct Smoke Detectors:

1. Photoelectric Smoke Detectors:

a. Sensor: LED or infrared light source with matching silicon-cell receiver.
b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

2. UL 268A listed, operating at 24-V dc, nominal.

3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACU.

4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.

5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status. Provide remote status and alarm indicator and test station where indicated.

7. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied. Sampling tubes shall extend the full length of the duct. Those over 36 inches long must be provided with far end support for stability.

8. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.5 HEAT DETECTORS

A. General: UL 521 listed.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or rate-of-rise of temperature that exceeds 15 deg F per minute, unless otherwise indicated.

1. Mounting: Plug-in base, interchangeable with smoke-detector bases.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACU.

2.6 NOTIFICATION APPLIANCES

A. Description: Equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn.

C. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.

1. Rated Light Output: As indicated on plan in candela.
2. Strobe Leads: Factory connected to screw terminals.

2.7 WIRE AND CABLE

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70.

B. Addressable loop (signaling line) circuits shall be wired with type FPL/FPLR/FPLP fire alarm cable, 18 AWG minimum, low capacitance, twisted shielded copper pair. Cabel shield drain wires are to be connected at each device on the loop to maintain continuity, taped to insulate from ground, and terminated at the FACU. Acceptable cables include Atlas 228-18-1-1STP, BSCC S1802s19, West Penn D975, D991 (AWG 16), D995 (AWG 14) or equal wire having capacitance of 30pf/ft. The cable jacket color shall be Red (+), and black (-) conductor insulation.Adjust wire size in first paragraph below to suit Project. NFPA 70 permits wire sizes down to No. 26 AWG.

Exception #1: Unshielded cable, otherwise equal to the above, is permitted to be used if the manufacturer's installation manual requires, or states preference for, unshielded cable.

C. All other circuits shall be wired with AWG 14, stranded copper, THHN/THWN conductors, installed in conduit. Color code as shown below.
Alarm notification circuit (horn/strobes) – Blue (+)/Black (-)
Separate 24V dc operating power (for equipment) Yellow (+)/Brown (-)

PART 3 - .EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Smoke or Heat Detector Spacing:

1. Smooth ceiling spacing shall not exceed 30 feet.
2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.
3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.

4. The FACU and all other control equipment locations, including any transponders, sub-panels, and booster power supplies, must be protected by a spot type smoke detector located within 15 feet of the equipment (measured horizontally).

B. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.

D. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

E. Audible Alarm-Indicating Devices: Install not less than 80 inches above finish floor or 96" to the top of device. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

F. Device Location-Indicating Lights: Locate in public space near the device they monitor.

G. FACU: Surface mount with tops of cabinets not more than 72 inches above the finished floor. The FACU and all other control equipment locations, including any transponders, sub-panels, and booster power supplies, must be protected by a spot type smoke detector located within 15 feet of the equipment (measured horizontally).

3.2 WIRING INSTALLATION

A. Install wiring according to the following:

1. NECA 1.
2. TIA/EIA 568-A.

B. Wiring Method: Install wiring in metal raceway according to Division 16 Section "Raceways and Boxes."

1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

C. Wiring Method:

1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of 2-hour fire-rated fire alarm cables, NFPA 70 Types MI and CI, is[**not**] permitted.
3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. For Class A circuits, provide separate conduits or cable for outgoing and return conductors.

3.3 GROUNDING

A. Ground the FACU and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACU.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters.
3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
4. Testing: Follow procedure and record results complying with requirements in NFPA 72.

    a. Detectors that are outside their marked sensitivity range shall be replaced.

5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.5 PROGRAMMING, TESTING AND CERTIFICATION

A. All connections to the FACU and the system's programming shall be done only by the manufacturer, or by an authorized distributor that stocks a full compliment of spare parts for the system. The technicians who do this are required to be trained and individually certified by the manufacturer, for the FACU model/series being installed. The training and certification must have occurred within the lost recent 24 months.

B. When programming the system, activate the automatic drift compensation feature for all spot type smoke detectors. Set spot type sensitivities to normal/medium.

C. Print a complete system status and programming report, after the above steps have been done. This must include the program settings for each alarm initiating device and current sensitivity of each analog addressable smoke detector.

D. The manufacturer or authorized distributor must 100% test all site specific software functions for the system and then provide a detailed report or check list showing the system's operational matrix.

E. Upon completion of the installation and its programming, the fire alarm technician shall test every alarm initiating device for proper response and indication, and all alarm notification appliances for effectiveness.

F. The contractor must fill out and submit the following documentation to the owner, through the Engineer, prior to the AHJ's system acceptance inspection.

1. The NFPA-72-1999 Figure 1-6.2.1, "Record of completion" form. Use this form to detail the system installation and also to certify that it was done per code and the code required 100% test was performed. If a representative of the AHJ, owner, or Engineer witnesses the tests, they sign the last line of the form to signify that fact only.

G. After completion of the 100% test and submission of documentation, the contractor is to request the Engineer to set up an inspection. The system must operate for at least two days prior to this inspection.

H. The fire alarm system will be inspected, with portions of it functionally tested. This will normally include the use of appropriate means to simulate smoke for testing detectors, as well as testing the system interface with building controls. The contractor provides two-way radios, ladders, and other materials needed for testing the system, including a suitable smoke source.

END OF SECTION 13851

SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS

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. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Mechanical demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.

4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 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 mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 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. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 150, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 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. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.
f. Viking Johnson.

2. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Fernco, Inc.
c. Mission Rubber Company.
d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

1. Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.

c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

2.6 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. Pipeline Seal and Insulator, Inc.
e. Thunderline Link Seal.

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.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With **concealed** hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 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 (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 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 according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.

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.

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 (50 mm) 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 (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using 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.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. 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 (25-mm) 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.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 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 mechanical 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.

3.5 PAINTING

E. Painting of mechanical systems, equipment, and components is specified in Division 9 Section.

F. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

G. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use **3000-psi (20.7-MPa)** 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.9 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 15050

SECTION 15055 - MOTORS

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 basic requirements for factory- and field-installed motors.

1.3 DEFINITIONS

A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

B. Field-Installed Motor: A motor installed at Project site and not factory installed as an integral component of motorized equipment.

1.4 SUBMITTALS

A. Product Data for Field-Installed Motors: For each type and size of motor, provide nameplate data and ratings; shipping, installed, and operating weights; enclosure type and mounting arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.

B. Shop Drawings for Field-Installed Motors: Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:

1. Each installed unit's type and details.
2. Nameplate legends.
3. Diagrams of power, signal, and control wiring. Provide schematic wiring diagram for each type of motor and for each control scheme.

C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around field-installed motors. Show motor layout, mechanical power transfer link, driven load, and relationship between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Manufacturer Seismic Qualification Certification: Submit certification that motors, accessories, and components will withstand seismic forces defined in Division 15 Section "Mechanical Vibration and Seismic Controls. Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Qualification Data: For testing agency.

F. Source quality-control test reports.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For field-installed motors to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Source Limitations: Obtain field-installed motors through one source from a single manufacturer.

C. Product Options for Field-Installed Motors: Drawings indicate size, profiles, and dimensional requirements of motors and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

D. 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.

E. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:

1. Compatible with the following:

a. Magnetic controllers.
b. Multispeed controllers.
c. Reduced-voltage controllers.

2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
3. Matched to torque and horsepower requirements of the load.
4. Matched to ratings and characteristics of supply circuit and required control sequence.

B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

A. Motor requirements apply to factory- and field-installed motors except as follows:

1. Different ratings, performance, or characteristics for motor are specified in another Section.
2. Motorized-equipment manufacturer requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

2.2 MOTOR CHARACTERISTICS

A. Motors 3/4 HP and Larger: Three phase.

B. Motors Smaller Than 3/4 HP: Single phase.

C. Frequency Rating: 60 Hz.

D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.

F. Duty: Continuous duty at ambient temperature of 105 deg F (40 deg C) and at altitude of 3300 feet (1005 m) above sea level.

G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

H. Enclosure: Open dripproof.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium, as defined in NEMA MG 1.

C. Stator: Copper windings, unless otherwise indicated.

1. Multispeed motors shall have separate winding for each speed.

D. Rotor: Squirrel cage, unless otherwise indicated.

E. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating, unless otherwise indicated.

G. Insulation: Class F, unless otherwise indicated.

H. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

I. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.

1. Finish: Gray enamel.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Designed with critical vibration frequencies outside operating range of controller output.
2. Temperature Rise: Matched to rating for Class B insulation.
3. Insulation: Class H.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Rugged-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with non-hygroscopic material.

1. Finish: Chemical-resistant paint over corrosion-resistant primer.

D. Source Quality Control for Field-Installed Motors: Perform the following tests on each motor according to NEMA MG 1:

1. Measure winding resistance.
2. Read no-load current and speed at rated voltage and frequency.
3. Measure locked rotor current at rated frequency.
4. Perform high-potential test.

2.5 SINGLE-PHASE MOTORS

A. Type: One of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.

C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

E. Source Quality Control for Field-Installed Motors: Perform the following tests on each motor according to NEMA MG 1:

1. Measure winding resistance.
2. Read no-load current and speed at rated voltage and frequency.
3. Measure locked rotor current at rated frequency.
4. Perform high-potential test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before motor installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIELD-INSTALLED MOTOR INSTALLATION

A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and align with load transfer link.

B. Install motors on concrete bases complying with Division 3.

C. Comply with mounting and anchoring requirements specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

3.3 FIELD QUALITY CONTROL FOR FIELD-INSTALLED MOTORS

A. Prepare for acceptance tests.

1. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer's written instructions.
2. Verify bearing lubrication.
3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
4. Test interlocks and control and safety features for proper operation.
5. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.

END OF SECTION 15055

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SECTION 15075 - MECHANICAL IDENTIFICATION

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. Duct markers.
7. Stencils.
8. Valve tags.
9. Valve schedules.
10. 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

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 (64 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) 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: 1/8 inch (3.2 mm), unless otherwise indicated.
4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

D. Access Panel and Door Markers: 1/16-inch- (1.6-mm-) thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch (3.2-mm) 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 (150 mm): Full-band pipe markers extending 360 degrees around pipe at each location.
4. Pipes with OD, Including Insulation, 6 Inches (150 mm) 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. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

C. Plastic Tape: Continuously printed, vinyl tape at least 3 mils (0.08 mm) thick with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

2.3 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.
1. Stencil Paint: Exterior, gloss, acrylic enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
2. Identification Paint: Exterior acrylic 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 (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers, with numbering scheme. Provide 5/32-inch (4-mm) hole for fastener.

1. Material: 0.032-inch- (0.8-mm-) thick brass or aluminum.
2. Valve-Tag Fasteners: Brass wire-link chain and 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: Extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches (100 by 178 mm).
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 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 boilers, furnaces, and heaters.
2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
4. Fans, blowers, primary balancing dampers, and mixing boxes.
5. Packaged HVAC central-station and zone-type units.

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 (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
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 boilers, furnaces, and heaters.
e. Pumps, compressors, chillers, condensers, and similar motor-driven units.
f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
g. Fans, blowers, primary balancing dampers, and mixing boxes.

h. Packaged HVAC central-station and zone-type units.
i. Tanks and pressure vessels.
j. 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. Identify mechanical equipment with equipment markers in the following color codes:

a. Green: For cooling equipment and components.
b. Yellow: For heating equipment and components.
c. Orange: For combination cooling and heating equipment and components.
d. Brown: For energy-reclamation equipment and components.

2. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
4. 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 boilers, furnaces, and heaters.
c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
e. Fans, blowers, primary balancing dampers, and mixing boxes.
f. Packaged HVAC central-station and zone-type units.
g. Tanks and pressure vessels.
h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

D. Install access panel markers with screws on equipment access panels.

3.3 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 (150 mm): Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 3/4 inch (19 mm) wide, lapped at least 1-1/2 inches (38 mm) at both ends of pipe marker, and covering full circumference of pipe.
2. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches (38 mm) wide, lapped at least 3 inches (75 mm) at both ends of pipe marker, and covering full circumference of pipe.

B. Stenciled Pipe Marker Option: Stenciled markers may be provided instead of manufactured pipe markers, at Installer's option. Install stenciled pipe markers complying with ASME A13.1 on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. 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 (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.4 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 HVAC terminal devices 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 (38 mm), round.
b. Hot Water: 1-1/2 inches (38 mm), round.
c. Fire Protection: 2 inches (50 mm), square.
d. Gas: 2 inches (50 mm), square.
e. Steam: 2 inches (50 mm), round.

2. Letter Color:

a. Cold Water: Black.
b. Hot Water: Black.
c. Fire Protection: Black.
d. Gas: Black.
e. Steam: Black.

3.5 VALVE-SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location in each major equipment room.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.8 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 15075

SECTION 15080 - MECHANICAL 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 mechanical insulation for boiler breeching, duct, equipment, and pipe, including the following:

1. Insulation Materials:
   a. Cellular glass.
   b. Flexible elastomeric.
   c. Mineral fiber.
   d. Polyisocyanurate.
2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Lagging adhesives.
7. Sealants.
8. Factory-applied jackets.
9. Field-applied fabric-reinforcing mesh.
10. Field-applied cloths.
11. Field-applied jackets.
12. Tapes.
13. Securements.
14. Corner angles.

B. Related Sections include the following:

1. Division 2 Section "Hydronic Distribution" for loose-fill pipe insulation in underground piping outside the building.
2. Division 2 Section "Steam Distribution" for loose-fill pipe insulation in underground piping outside the building.
3. Division 15 Section "Metal Ducts" for duct liners.

1.3 DEFINITIONS

A. ASJ: All-service jacket.

B. FSK: Foil, scrim, kraft paper.

C. FSP: Foil, scrim, polyethylene.

D. PVDC: Polyvinylidene chloride.

E. SSL: Self-sealing lap.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings: Show details for the following:

1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Attachment and covering of heat tracing 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, equipment connections, and access panels.
6. Application of field-applied jackets.
7. Application at linkages of control devices.
8. Field application for each equipment type.

C. Installer Certificates: Signed by Contractor certifying that installers comply with requirements.

D. Field quality-control inspection reports.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before

preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INSULATION MATERIALS

A. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Block Insulation: ASTM C 552, Type I.
2. Special-Shaped Insulation: ASTM C 552, Type III.
3. Board Insulation: ASTM C 552, Type IV.
4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.

5. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products:

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products:

a. CertainTeed Corp.; Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; All-Service Duct Wrap.

I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products:

a. CertainTeed Corp.; Commercial Board.
b. Fibrex Insulations Inc.; FBX.
c. Johns Manville; 800 Series Spin-Glas.
d. Knauf Insulation; Insulation Board.
e. Manson Insulation Inc.; AK Board.
f. Owens Corning; Fiberglas 700 Series.

J. Mineral-Fiber, Preformed Pipe Insulation:

1. Products:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000(Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semi-rigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products:

   a. CertainTeed Corp.; CrimpWrap.
   b. Johns Manville; MicroFlex.
   c. Knauf Insulation; Pipe and Tank Insulation.
   d. Manson Insulation Inc.; AK Flex.
   e. Owens Corning; Fiberglas Pipe and Tank Insulation.

L. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.

1. Products:

   a. Apache Products Company; ISO-25.
   b. Dow Chemical Company (The); Trymer.
   c. Duna USA Inc.; Corafoam.
   d. Elliott Company; Elfoam.

2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.
3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches (38 mm) as tested by ASTM E 84.
4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in Part 2 "Factory-Applied Jackets" Article.

   a. Pipe Applications: ASJ.
   b. Equipment Applications: ASJ.

2.3 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F (927 deg C). Comply with ASTM C 656, Type II, Grade 6. UL tested and certified to provide a 2-hour fire rating.

1. Products:

   a. Johns Manville; Super Firetemp M.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is UL tested and certified to provide a 2-hour fire rating.

1. Products:

   a. CertainTeed Corp.; FlameChek.
   b. Johns Manville; Firetemp Wrap.
   c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
   d. Thermal Ceramics; FireMaster Duct Wrap.
   e. 3M; Fire Barrier Wrap Products.
   f. Unifrax Corporation; FyreWrap.
   g. Vesuvius; PYROSCAT FP FASTR Duct Wrap.

2.4 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products:

a. Insulco, Division of MFS, Inc.; SmoothKote.
b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
c. Rock Wool Manufacturing Company; Delta One Shot.

2.5 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass, Polyisocyanurate, Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products:

a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. RBX Corporation; Rubatex Contact Adhesive.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products:

   a. Dow Chemical Company (The); 739, Dow Silicone.
   b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
   c. P.I.C. Plastics, Inc.; Welding Adhesive.
   d. Red Devil, Inc.; Celulon Ultra Clear.
   e. Speedline Corporation; Speedline Vinyl Adhesive.

2.6 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products:

   a. Childers Products, Division of ITW; CP-35.
   b. Foster Products Corporation, H. B. Fuller Company; 30-90.
   c. ITW TACC, Division of Illinois Tool Works; CB-50.
   d. Marathon Industries, Inc.; 590.
   e. Mon-Eco Industries, Inc.; 55-40.
   f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products:

   a. Childers Products, Division of ITW; CP-30.
   b. Foster Products Corporation, H. B. Fuller Company; 30-35.
   c. ITW TACC, Division of Illinois Tool Works; CB-25.
   d. Marathon Industries, Inc.; 501.
   e. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products:

   a. Childers Products, Division of ITW; Encacel.
   b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
   c. Marathon Industries, Inc.; 570.
   d. Mon-Eco Industries, Inc.; 55-70.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

2.7 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Products:

   a. Childers Products, Division of ITW; CP-52.
   b. Foster Products Corporation, H. B. Fuller Company; 81-42.
   c. Marathon Industries, Inc.; 130.
   d. Mon-Eco Industries, Inc.; 11-30.
   e. Vimasco Corporation; 136.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F (Minus 46 to plus 82 deg C).
4. Color: White.

2.8 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, and Polyisocyanurate Products:

   a. Childers Products, Division of ITW; CP-76.
   b. Foster Products Corporation, H. B. Fuller Company; 30-45.
   c. Marathon Industries, Inc.; 405.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Pittsburgh Corning Corporation; Pittseal 444.
   f. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
5. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Products:

   a. Childers Products, Division of ITW; CP-76-8.
   b. Foster Products Corporation, H. B. Fuller Company; 95-44.
   c. Marathon Industries, Inc.; 405.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: White.

2.9 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
3. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms (0.013 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
5. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms (0.007 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

    a. Available Products:

        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

7. Vinyl Jacket: UL-rated white vinyl with a permeance of 1.3 perms (0.86 metric perms) when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.10 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. inch (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.

B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. inch (2 strands by 2 strands/sq. mm) for covering equipment.

C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. inch (4 strands by 4 strands/sq. mm), in a Leno weave, for duct, equipment, and pipe.

2.11 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

2.12 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color as selected by Architect.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:

1. Products:

a. Childers Products, Division of ITW; Metal Jacketing Systems.
b. PABCO Metals Corporation; Surefit.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper
d. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.

5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Underground Direct-Buried Jacket: 125-mil- (3.2-mm-) thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

F. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

2.13 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.

1. Products:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.

1. Products:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corp.; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
b. Compac Corp.; 130.
c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
d. Venture Tape; 1506 CW NS.

2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.

1. Products:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
b. Compac Corp.; 120.
c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.14 SECUREMENTS

A. Bands:

1. Products:

a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

a. Products:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.

4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

a. Products:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.
5)

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

1. Manufacturers:

a. ACS Industries, Inc.
b. C & F Wire.
c. Childers Products.
d. PABCO Metals Corporation.
e. RPR Products, Inc.

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.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water.

3.3 COMMON INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for

fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Through-Penetration Firestop Systems."

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies according to Division 7 Section "Through-Penetration Firestop Systems."

3.5 DUCT AND PLENUM INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

3.6 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
    d. Do not overcompress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches (75 mm).
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from galvanized steel, at least 0.040 inch (1.0 mm) thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.7 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For

valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.8 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.9 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-(150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent

insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-(150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.11 POLYISOCYANURATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch (38-mm) thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

C. Insulation Installation on Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of polyisocyanurate insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.12 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.13 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous UL-listed fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 7 Section "Through-Penetration Firestop Systems."

3.14 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.15 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply, return, exhaust and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
4. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
5. Indoor, concealed oven exhaust.
6. Indoor, exposed oven exhaust.

B. Items Not Insulated:

1. Factory-insulated flexible ducts.
2. Factory-insulated plenums and casings.
3. Flexible connectors.
4. Vibration-control devices.
5. Factory-insulated access panels and doors.

3.16 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, duct insulation shall be any of the following:

1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

B. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

C. Exposed, round supply-air duct insulation shall be factory insulated. Exposed, round supply ductwork shall be double wall construction; see section 15815.

D. Exposed, round and rectangular return-air duct insulation shall be uninsulated.

E. Exposed, round and rectangular exhaust-air duct insulation shall be uninsulated.

3.17 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Chillers: Insulate cold surfaces on chillers, including, but not limited to, evaporator bundles, condenser bundles, suction piping, compressor inlets, tube sheets, water boxes, and nozzles with any of the following:

1. Cellular Glass: 2 inches (50 mm) thick.
2. Flexible Elastomeric: 1 inch (25 mm) thick.
3. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.

4. Polyisocyanurate: 1 inch (25 mm) thick.

D. Chilled-water pump insulation shall be any of the following:

1. Cellular Glass: 3 inches (75 mm) thick.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
3. Polyisocyanurate: 1-1/2 inches (38 mm) thick.

E. Domestic water pump insulation shall be any of the following:

1. Cellular Glass: 2 inches (50 mm) thick.
2. Mineral-Fiber Board: 1 inch (25 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
3. Polyisocyanurate: 1 inch (25 mm) thick.

F. Heating-hot-water pump insulation shall be any of the following:

1. Calcium Silicate: 3 inches (75 mm) thick.
2. Cellular Glass: 3 inches (75 mm) thick.
3. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

G. Chilled-water expansion/compression tank insulation shall be any of the following:

1. Cellular Glass: 2 inches (38 mm) thick.
2. Flexible Elastomeric: 1 inch (25 mm) thick.
3. Mineral-Fiber Board: 1 inch (25 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
4. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.
5. Polyisocyanurate: 1 inch (25 mm) thick.

H. Heating-hot-water expansion/compression tank insulation shall be any of the following:

1. Cellular Glass: 1-1/2 inches (38 mm) thick.
2. Mineral-Fiber Board: 1 inch (25 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
3. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.

I. Chilled-water air-separator insulation shall be any of the following:

1. Cellular Glass: 2 inches (50 mm) thick.
2. Flexible Elastomeric: 1 inch (25 mm) thick.
3. Mineral-Fiber Board: 1 inch (25 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
4. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.
5. Polyisocyanurate: 1 inch (25 mm) thick.

J. Heating-hot-water air-separator insulation shall be any of the following:

1. Cellular Glass: 3 inches (75 mm) thick.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
3. Mineral-Fiber Pipe and Tank: 2 inches (50 mm) thick.

K. Domestic hot-water storage tank insulation shall be either of the following:

1. Mineral-Fiber Board: 4 inches (100 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
2. Mineral-Fiber Pipe and Tank: 4 inches (100 mm) thick.

3.18 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Fire-suppression piping.
2. Drainage piping located in crawl spaces.
3. Below-grade piping.
4. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.19 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 (DN 25) and Smaller: Insulation shall be either of the following:
   a. Flexible Elastomeric: 3/4 inch (19 mm) thick.
   b. Mineral-Fiber Pipe Insulation, Type I: 1 inch (25 mm) thick.

2. NPS 1-1/4 (DN 32) and Larger: Insulation shall be either of the following:
   a. Flexible Elastomeric: 1 inch (25 mm) thick.
   b. Mineral-Fiber Pipe Insulation, Type I: 1 inch (25 mm) thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be either of the following:
   a. Flexible Elastomeric 1 inch (25 mm) thick.
   b. Mineral-Fiber Pipe Insulation, Type I: 1 inch (25 mm) thick.

2. NPS 1-1/2 (DN 40) and Larger: Insulation shall be either of the following:
   a. Flexible Elastomeric: 1 inch (25 mm) thick.
   b. Mineral-Fiber Pipe Insulation, Type I: 1 inch (25 mm) thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be either of the following:
   a. Flexible Elastomeric: 1 inch (25 mm) thick.
   b. Mineral-Fiber Pipe Insulation, Type I: 1 inch (25 mm) thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be either of the following:
   a. Flexible Elastomeric: 1 inch (25 mm) thick.
   b. Mineral-Fiber Pipe Insulation, Type I: 1 inch (25 mm) thick.

E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following:

   a. Flexible Elastomeric: 1/2 inch (13 mm) thick.

F. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 3/4 inch (19 mm) thick.

G. Floor Drains, Traps, and Sanitary Drain Piping within 20 Feet (3 m) of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 3/4 inch (19 mm) thick.

H. Chilled Water, above 40 Deg F (5 Deg C):

1. NPS 12 (DN 300) and Smaller: Insulation shall be any of the following:

   a. Cellular Glass: 2 inches (50 mm) thick.
   b. Flexible Elastomeric: 1 inch (25 mm) thick.
   c. Polyisocyanurate: 1-1/2 inches (38 mm) thick.
   d. Polyolefin: 1 inch (25 mm) thick.

I. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and below:

1. NPS 12 (DN 300) and Smaller: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches (50 mm) thick.

J. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch (25 mm) thick.

3.20 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation shall be either of the following:

   a. Cellular Glass: 2 inches (50 mm) thick.
   b. Polyisocyanurate: 2 inches (50 mm) thick.

B. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation shall be either of the following:

   a. Cellular Glass: 2 inches (50 mm) thick.
   b. Polyisocyanurate: 2 inches (50 mm) thick.

C. Chilled Water:

1. All Pipe Sizes: Insulation shall be either of the following:

   a. Cellular Glass: 3 inches (75 mm) thick.
   b. Polyisocyanurate: 2 inches (50 mm) thick.

3.21 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
1. PVC: 20 mils (0.5 mm) thick.
2. Aluminum, Smooth: 0.016 inch (0.41 mm) thick.

D. Equipment, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):
1. Painted Aluminum, Smooth with 1-1/4-Inch- (32-mm-) Deep Corrugations thick.

E. Piping, Exposed:
1. 8 ounce canvas with lagging adhesive.

3.22 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:
1. Aluminum, Smooth: 0.020 inch (0.51 mm) thick.

END OF SECTION 15080

SECTION 15122 - METERS AND GAGES

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 meters and gages for mechanical systems:

1. Thermometers.
2. Gages.
3. Test plugs.

B. Related Sections include the following:

1. Division 2 Section "Water Distribution" for domestic and fire-protection water service meters outside the building.
2. Division 2 Section "Natural Gas Distribution" for gas meters outside the building.

1.3 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

B. Shop Drawings: Schedule for thermometers gages indicating manufacturer's number, scale range, and location for each.

C. Product Certificates: For each type of thermometer gage signed by product manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to 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, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:

1. Palmer - Wahl Instruments Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Chrome-plated brass, 7 inches (178 mm) long.

C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

E. Window: Glass .

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 THERMOWELLS

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. Marsh Bellofram.
5. Miljoco Corp.
6. NANMAC Corporation.
7. Noshok, Inc.
8. Palmer - Wahl Instruments Inc.
9. REO TEMP Instrument Corporation.
10. Tel-Tru Manufacturing Company.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.

B. Manufacturers: Same as manufacturer of thermometer being used.

C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.4 PRESSURE GAGES

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. Eugene Ernst Products Co.
5. KOBOLD Instruments, Inc.
6. Marsh Bellofram.
7. Miljoco Corp.
8. Noshok, Inc.
9. Palmer - Wahl Instruments Inc.
10. REO TEMP Instrument Corporation.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Liquid-filled type, drawn steel or cast aluminum, 4-1/2-inch (114-mm) diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4 (DN 8), bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass.
8. Ring: Stainless steel.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure (100 kPa of vacuum to 103 kPa of pressure).
11. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 (DN 8) brass or stainless-steel needle type.
2. Syphons: NPS 1/4 (DN 8) coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 (DN 8) brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.5 TEST PLUGS

A. Manufacturers:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.

4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Co.
6. Trerice, H. O. Co.
7. Watts Industries, Inc.; Water Products Div.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).

D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F (minus 7 to plus 93 deg C) shall be CR.
2. Insert material for air or water service at minus 30 to plus 275 deg F (minus 35 to plus 136 deg C) shall be EPDM.

E. Test Kit: Furnish one test kit(s) containing one pressure gage and adaptor, one thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be 0 to 200 psig (0 to 1380 kPa)
2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F (minus 4 to plus 52 deg C).
3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F (minus 18 to plus 104 deg C).
4. Carrying case shall have formed instrument padding.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers as indicated on drawings.

B. Provide the following temperature ranges for thermometers:

1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions (Minus 1 to plus 82 deg C, with 1-degree scale divisions)
2. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions (Minus 1 to plus 115 deg C, with 1-degree scale divisions).
3. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions (Minus 18 to plus 38 deg C, with 1-degree scale divisions)] [0 to 160 deg F, with 2-degree scale divisions (Minus 18 to plus 71 deg C, with 1-degree scale divisions).

3.2 GAGE APPLICATIONS

A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.

B. Install liquid-filled-case-type pressure gages at chilled-water inlets and outlets of chillers.

C. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.

C. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.

D. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.

E. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

F. Install remote-mounting pressure gages on panel.

G. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).

H. Install needle-valve and syphon fitting in piping for each pressure gage for steam.

I. Install test plugs in tees in piping.

J. Install connection fittings for attachment to portable indicators in accessible locations.

3.4 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

3.5 ADJUSTING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 15122

SECTION 15501 - ELECTRICAL REQUIREMENTS FOR HVAC EQUIPMENT

PART I - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division - 1 Specifications sections, apply to work of this section.

B. Related Sections: Separate electrical components and materials required for field installation and electrical connections are specified in Division 16.

1.2 SUMMARY

A. This section specifies the basic requirements for electrical components which may or may not be an integral part of the HVAC equipment. These components include, but are not limited to motors, motor starters, and disconnect switches.

B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for HVAC equipment are specified within the individual equipment specification sections, and/or are scheduled on the drawings.

C. All electrical work shall be done by licensed electricians in accordance with the N.C. State Building Code which includes the National Electrical Code, latest edition and the Electrical Division of this specification. Furnish a certificate to the appropriate Electrical Inspector.

D. Work Included:

1. All power wiring and associated conduit shall be provided to HVAC equipment by the Electrical Contractor. The HVAC Contractor shall furnish all motor starters, disconnect switches, and combination starters for HVAC equipment and turn them over to the Electrical Contractor for installation. All final power wiring connections to HVAC equipment shall be made by the HVAC Contractor from slack wire left by the Electrical Contractor. Refer to the Mechanical Contract Drawings for division responsibility regarding electrical requirements.

2. Provide all control wiring, in conduit, required to satisfactorily control all equipment included in this section. Furnish and wire all control devices such as thermostats, switches, relays and any other devices necessary to control the equipment furnished in this section.

3. Duct mounted smoke detectors shall be furnished by the Electrical Contractor and installed in ductwork by the HVAC Contractor. Wiring to the fire alarm system shall be provided by the Electrical Contractor. Additional control wiring from the detector's auxiliary contacts shall be provided by the HVAC Contractor. Detectors shall be installed in strict accordance with manufacturer's installation instructions and/or NFPA.

1.3 REFERENCES

A. NEMA Standards ICS 2.

B. NEMA Standard 250.

C. NEMA Standard KS 1.

D. National Electrical Code (NFPA 70).

E. N.C. State Building Code.

1.4 SUBMITTALS

A. Provide a separate electrical submittal for all field mounted starters and disconnects not included as integral pieces of HVAC equipment. Submittal shall conform to requirements of Division 1 and Division 16.

B. For HVAC equipment with integral starters and/or disconnects no separate electrical submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

C. Before any electrical work is performed submit wiring diagrams and methods of powering and controlling all electrically connected or operated equipment to the Architect for approval. Controls subcontractor shall check and approve all diagrams before submittal to the Engineer. The diagrams shall show points of connection of equipment to system provided by the Electrical Contractor and shall show conduit and wire sizes.

1.5 QUALITY ASSURANCE

A. All electrical equipment and materials shall be UL labeled.

PART 2 – PRODUCTS

2.1 DISCONNECT SWITCHES

A. Shall conform to all requirements specified in Section 16410 - "Enclosed Switches and Circuit Breakers".

2.2 MOTOR STARTERS AND COMBINATION STARTERS

A. Shall conform to all requirements specified in Section 16420 - "Enclosed Controllers".

PART 3 – EXECUTION

3.1 Conductor sizes shall be as specified in the National Electrical Code.

3.2 Control circuits shall be 120 volts or 24 volts. Provide in-line toggle switch at each control panel and starter control circuit to disconnect control power.

3.3 Ground all equipment per requirements of the National Electrical Code.

3.4 Equipment overcurrent protection and conductors in the electrical contract shall be sized to accommodate most major brands of HVAC equipment. If the HVAC Contractor chooses to use an item of equipment that exceeds the capacity of the electrical overcurrent protection and conductors, or requires multiple circuits, the HVAC Contractor shall be responsible for any additional cost required to increase the size of the overcurrent protection and conductors or provide the additional circuits and disconnects at no additional cost to the Owner or Electrical Contractor. He shall also coordinate this work with the Electrical Contractor to assure proper electrical service to the equipment.

END OF SECTION 15501

SECTION 15746 - GEOTHERMAL WELL FIELD SYSTEM

PART 1 - GENERAL

1.1 REFERENCES
The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

INTERNATIONAL GROUND SOURCE HEAT PUMP ASSOCIATION (IGSHPA)

OSU/IGSHPA-2	Closed-Loop/Ground-Source Heat Pump System/Installation Guide

1.2 DESCRIPTION OF WORK
The work includes the performance of soil thermal-conductivity tests, design and installation of ground loop water systems and ground heat exchangers.

1.2.1 Soil Thermal-conductivity Tests
The performance of soil thermal conductivity tests shall be provided in compliance with the testing procedures indicated herein, in the quantity indicated on the Schedule of Values, and in the locations indicated by the Project Manager.

1.2.2 Ground Loop and Ground Heat Exchanger Tests
Testing and reporting of the ground loop piping and ground heat exchangers shall be performed on all ground heat exchanger systems in compliance with the testing and reporting procedures indicated herein. Testing shall be performed by IGSHPA certified personnel.

1.3. DEFINITIONS

1.3.1 Out-of-Tolerance Data
A measurement taken during field checking that does not fall within the range of plus 10 to minus 10 percent of a design for a specific parameter.

1.4 SUBMITTALS
Submit the following in accordance with Division 1, Submittal Procedures.

1.4.1 SD-12, Field Test Reports

1.4.1.1 Certified Testing Reports
Submit the certified TESTING report with a certification statement which attests that the procedures executed have been in full compliance with the requirements of IGSHPA. Certifications shall further attest that any/all known deficiencies in operation, performance, or water flows are clearly identified herein.

1.4.1.2 Report Format
Submit completed report forms for each of the following as a minimum, Report all data on standard IGSHPA report forms as contained within the referenced standards or as specified herein:

a. Soil Thermal Conductivity Tests

b. Ground Loop and Ground Heat Exchanger Tests

1.4.1.3 Final Report
The final report shall be neatly bound with a waterproof cover. It shall contain a table of contents with each page numbered. All report data shall be typed. Handwritten data will not be acceptable.

1.4.2 Instruments
List the types of instruments actually used to measure the TESTING data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

1.5 QUALITY ASSURANCE

1.5.1 Modifications of References
Accomplish geothermal well field testing, design and installation of wells and ground-coupled heat exchanger work in accordance with referenced publications of IGSHPA except as modified by this section. In the references referred to herein, consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may" wherever they appear. Interpret reference to the "authority having jurisdiction," the "Administrative Authority," the "Owner," or the "Design Engineer" to mean the Project Manager.

1.5.2 Qualifications of Ground Heat Exchanger Fabricators
The only acceptable method for joining buried pipe systems is by a heat fusion process. Ground heat exchanger fabricators shall have completed a heat fusion school in which each participant has performed a heat fusion procedure under direct supervision of an approved manufacturing certification program, or an IGSHPA certified heat fusion technician. Certified technicians shall attend a retraining school annually.

1.5.3 Qualifications of Ground Heat Exchanger Installers
Installers shall have completed an approved manufacturer's certification program and shall have successfully completed at least 10 projects with ground heat exchanger work similar in size and scope as for this project and have a minimum of 5 years of experience. Installers shall be IGSHPA certified.

PART 2 - PRODUCTS

2.1 GROUND HEAT EXCHANGER PIPING SYSTEMS
Provide polyethylene pipe and fittings for the underground portions of the ground heat exchanger. Use of polyvinyl chloride (PVC) pipe and fittings is not permitted.

2.1.1 Polyethylene Pipe
Pipe shall be manufactured from virgin high density polyethylene extrusion material in accordance with ASTM D 2513 with PE345434C or PE355434C cell classification and UV stabilizer of C, D, or E as specified in ASTM D 3350. Provide ASTM D 3035 pipe with a standard dimension ratio (SDR) of 11.0 for pipe less than 1.25 inches diameter. Provide ASTM D 2447, Schedule 40 or ASTM D 3035 pipe with a minimum SDR of 13.5 for pipe 1.25 inches

diameter or greater. Provide ASTM D 3035 pipe in vertical bores greater than 200 feet deep with an SDR of 11.0.

2.1.2 Fittings
Provide ASTM D 3261 butt and saddle fusion fittings and ASTM D 2683 socket fusion fittings manufactured in accordance with ASTM D 2513. Barbed fittings and hose clamps are not permitted in polyethylene pipe systems.

2.1.3 U-bends
Provide factory-fused, injection-molded 180 degree U-bend assemblies equipped with anti-buoyancy devices.

2.1.4 Threaded Transition Fittings
Provide ASTM D 2513 reinforced threaded steel-to-polyethylene fittings. Fittings shall have a factory applied external epoxy coating.

PART 3 - EXECUTION

3.1 SOIL THERMAL-CONDUCTIVITY TESTS
Soil thermal-conductivity tests shall be performed on selected production boreholes in accordance with the Schedule of Values and as directed by the Project Manager. All tests shall be performed under the supervision of IGSHPA certified personnel with a minimum of 10 successfully completed projects. A list of prior tests shall be supplied upon request. The soil thermal-conductivity tests shall be completed and the test reports accepted prior to proceeding with the installation of the ground heat exchangers.

3.1.1 Test Equipment
The testing equipment shall be designed so that an uninterrupted constant flow of heated water is supplied to the U-bend assembly in the vertical ground heat exchanger. The testing device shall provide for the automatic collection of data at predetermined time intervals with a minimum time interval of 5 minutes. Collected data shall be provided to the Project Manager in an electronic format compatible with Microsoft Excel®.

3.1.2 Insulation
The testing device shall be designed to prevent heat loss to the environment external o the ground heat exchanger. Each end of the U-bend assembly shall be insulated with a closed-cell insulation to prevent heat loss or heat gain in the above ground piping.

3.1.3 Elapsed Time Before Testing
When using compressed air drilling, the test shall be scheduled to start no sooner than 24-hours after the final bore completion.

3.1.4 Input Heat Rate
A constant rate of heat input into the U-bend assembly shall be provided that is not less than 45 btu/hr (13.18W) per bore foot. The heat rate shall not be altered during the duration of the thermal conductivity test. The heat input rate shall be documented in the final report.

3.1.5 Data Acquisition
Data shall be recorded at 5-minute intervals throughout the duration of the test. Collected data shall include the temperature of the fluid entering the U-bend, temperature of the fluid returning from the U-bend, ambient air temperature within the test unit compartment, ambient outdoor air

temperature, and the watts input.

3.1.6 Test Duration

The duration of the thermal conductivity test shall be a minimum of 40 hours from the initial starting time. Power interruptions shall be avoided. In the event that there is a power interruption that is longer than 5 minutes, power shall be restored as soon as possible. At the determination of the Project Manager, the borehole shall be allowed to thermally rest for a period of at least 96-hours prior to restarting the test.

3.2 GCHP, GROUND LOOP AND GROUND HEAT EXCHANGER SYSTEM TESTS

Upon completion and before final acceptance of work, test each system in service to demonstrate compliance with the contract requirements. Adjust controls and balance systems prior to final acceptance of completed systems. Test controls through every cycle of operation. Test safety controls to demonstrate performance of required function. Correct defects in work provided by Contractor and repeat tests. Furnish fuel, water, electricity, instruments, connecting devices, and personnel for tests. Flush and clean piping before placing in operation. Clean equipment, piping, strainers, ducts, and filters.

3.2.1 Test of Ground Heat Exchanger Piping

Before backfill the trenches, flush and purge systems of air and flow test to ensure all portions of the heat exchanger are properly flowing using the procedures recommended by OSU/IGSHPA-2. Utilize a portable temporary purging unit consisting of a high volume and high head purge pump, an open reservoir, a filter assembly with bypass, a flow meter, a pressure gage, and connecting piping.

3.2.2 Connecting hoses

Using a purge pump and the procedures recommended by OSU/IGSHPA-2, flush and purge each ground heat exchanger system until free of air, dirt, and debris. A velocity of 2 feet/sec is required in pipe sections to remove the air.

3.2.3 Flushing and Purging

Perform the flushing and purging operation with the water source heat pumps isolated by shutoff valves from the ground heat exchanger system. Allow purge pump to run 15 minutes after the last air bubbles have been removed. After the ground heat exchanger is completely flushed of air and debris, open the isolation valves and permit circulation through the heat pumps until the entire system is flushed and purged. Utilizing the purging unit and the procedures recommended by OSU/IGSHPA-2, conduct a pressure and flow test on the ground heat exchanger to ensure the system is free of blockage. If the flow test indicates blockage, locate the blockage using the manufacturer's recommendation, remove the blockage, then repeat the purge procedure and conduct the pressure and flow test again until all portions of the system are free flowing. The flow test shall be observed and approved by the Project Manager.

3.3 GROUND HEAT EXCHANGER PIPING

Examine areas and conditions under which ground heat exchanger systems will be installed. Prior to excavation, trenching, or drilling, locate and mark buried utilities. Do not proceed with work until approved by the Project Manager. Avoid sharp bends in piping. Provide fittings for changes in direction when minimum bend radius, as recommended by the pipe manufacturer, is exceeded. Use only continuous pipe in sharp bends. Make changes in piping sizes through tapered concentric fittings. Leaks shall be "cut-out" and replaced in accordance with the pipe manufacturer's recommendations. Direct buried threaded connections are not permitted.

3.3.1 Vertical Well Fields

Each U-bend loop shall be assembled, laid out straight, taped to reduce spring back, and water pressure tested at 100 psi for leaks and flow by OSU/IGSHPA-2 recommended procedures before pipe is inserted in the bore hole. Vertical bores shall be 5 feet deeper than the length of the loop and shall be clean (no casing) and of sufficient diameter to facilitate the installation of the U-bend assembly and a third pipe for pressure grouting. Fill the loop with water and pressurize to 40 psi to prevent the pipe from being crushed by backfill material. Backfill the bores from the bottom up with a high solids bentonite grout material and grouting process in conformance with OSU/IGSHPA-1 to ensure pipe contact and compliance with local and State requirements for sealing. Bentonite grout shall be prepared in accordance with manufacturer's recommendations for water-to-mix ratio. The bores shall not contain large, sharp, or jagged rocks or debris. Take reasonable and prudent care during installation and backfill to not crush, cut, or kink the pipe. If the loop is not immediately joined to the header, it shall be taped or capped.

3.3.2 Polyethylene Piping

Install piping in accordance with manufacturer's written instructions. During installation, keep trash, soil, and foreign objects out of the pipe. Tape or cap ends of the pipe until the pipe is joined to the circuit. Completely remove the cutout on the saddle tees. Use bell reductions at pipe reductions. Use reducing socket tees when fabricating socket type reducing headers. Avoid sharp bends in piping. Consult pipe manufacturer for minimum bend radius. Install elbow fittings at changes in pipe direction that are tighter than the minimum recommended bend radius. Use only continuous pipe in vertical U-bend loops.

3.3.3 Heat Fusion Process

Joining shall be either by butt, socket, or saddle (for side wall applications only) fusion in accordance with the manufacturer's Heat Qualification Guide. Use socket fusion joints for pipe 2 inches diameter and less. Different plastics or grades of plastic shall not be fused together.

3.3.4 Pressurizing

After assembly of the entire ground loop system, fill the system with water and pressure test to 100 psi. Visually inspect welds prior to backfill of the trenches.

3.3.5 Pipe Identification

Install metal (detectable) warning and identification tape above each horizontal pipe run. Install tape a minimum of 6 inches below finish grade. Install mechanical identification of vertical bore holes and connecting headers.

3.4 Flushing the Ground Heat Exchanger and Internal Piping.

Once the inside piping and external ground loop is connected, purge the system using a purge cart approved by the engineer. Using the purge valves first purge the ground loop, then purge the interior piping and the unit. Purge in accordance with OSU/IGSHPA-2 recommendations and leave filled with clean water. The contractor shall provide water analysis to the engineer prior to charging systems. If water is not acceptable then the system is to be charged with clean distilled water.

3.5 Final System Charge.

The final system charge shall be 25% by volume propylene glycol with corrosion inhibitors as recommended by the water-source heat pump manufacturer.

3.6 Form 1, "Ground Heat Exchanger Inspection and Test Report", at the end of this section,

shall be completed for each system by the QC Manager after completion of the before the systems can be backfilled.

3.7 Report Acceptance

The Contractor shall prepare, assemble, and submit the final certified Testing report in the required format for final review and approval.

END OF SECTION 15746

FORM 1

GROUND HEAT EXCHANGER (GHX) INSPECTION AND TEST REPORT

NOTE: Use a separate form for each GHX loop system.

Building:_____ Inspection Date:_____

Ground Heat Exchanger No. or Description:_____

List the GCHP Unit No.'s served by this GHX: _____

Ground Heat Exchanger Design Water Flow - _____ gpm

Calculated purging flow and press to achieve 2 feet/sec

Purging: Flow _____ gpm Head _____ psi, Duration of test _____ min.

Hydrostatic test pressure _____ psi; Duration _____ min.

Did the system pass the pressure test? _____

Has a dimensioned drawing been prepared, completely and accurately showing the layout of the ground heat exchanger? _____

Does the layout differ substantially from the contract documents? _____
If so is the deviation approved? _____

Depth of installed vertical loops is _____ feet. (Design is ____ feet.)

Depth of horizontal piping is _____ feet. (Design is _____ feet.)

Are the trenches clear of sharp bends, rocks, or other sharp objects that could restrict flow?_____

Are all joints heat fused (butt-, socket-, or saddle-fusion)?_____
Do the joints have the proper amount of roll-out?_____

Has the piping material been cut-out and properly removed from saddle-fusion tees?_____

Was the system backfilled properly with good clean backfill material? ____

Comments:_____

Inspected and approved this _____ date by _____

Title: _____

SECTION 15767 - PROPELLER UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes propeller unit heaters with electric-resistance coils.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each unit type and configuration.

B. Shop Drawings: Submit the following for each unit type and configuration:

1. Plans, elevations, sections, and details.
2. Details of anchorages and attachments to structure and to supported equipment.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.

C. Coordination Drawings: Plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which unit heaters will be attached.
3. Other items, including the following:

    a. Lighting fixtures.
    b. Sprinklers.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

1.4 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

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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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Raywall.
2. Trane.
3. Markel.

2.2 UNIT HEATERS

A. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

B. Comply with UL 2021.

2.3 CASING

A. Cabinet: Removable panels for maintenance access to controls.

B. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.

C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

2.4 ELECTRIC-RESISTANCE HEATING ELEMENTS

A. Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch (4 mm). Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F (288 deg C) at any point during normal operation.

1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

2.5 FAN

A. Propeller type, aluminum wheel directly mounted on motor shaft in the fan venturi.

2.6 FAN MOTORS

A. Comply with requirements in Division 15 Section "Motors."

B. Motor Type: Permanently lubricated.

2.7 CONTROLS

A. Control Devices:
1. Unit-mounted thermostat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before propeller unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install propeller unit heaters level and plumb.

B. Install propeller unit heaters to comply with NFPA 90A.

C. Suspend propeller unit heaters from structure as specified in Division 15 Section "Hangers and Supports." and "Mechanical Vibration and Seismic Controls."

3.3 CONNECTIONS

A. Ground equipment according to Division 16 Section "Grounding and Bonding."

B. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing and report results in writing:

1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.

B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 15767

SECTION 15785 - AIR-TO-AIR ENERGY RECOVERY UNITS

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. Heat wheels.
2. Packaged energy recovery units.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other Work. For installed products indicated to comply with design loads, include structural analysis data.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
4. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain air-to-air energy recovery units through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of air-to-air energy recovery units and are based on the specific system indicated.

C. 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.

D. ASHRAE Compliance: Capacity ratings for energy recovery devices shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: Furnish two spare sets of each type of filter specified.
2. Fan Belts: Furnish two spare sets of belts for each belt-driven fan in energy recovery units.
3. Wheel Belts: Furnish two spare sets of belts for each heat wheel.

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.

2.2 ENERGY WHEELS

A. Manufacturers:

1. Advanced Thermal Technologies.
2. American Energy Exchange.
3. Munters; Cargocaire Division.
4. SEMCO Incorporated.
5. Trane Company (The); Worldwide Applied Systems Group.
6. U.S. Rotors, Inc.

B. Casing: Steel with manufacturer's standard paint coating. Include the following:

1. Integral purge section.
2. Casing seals on periphery of rotor, on duct divider, and on purge section.
3. Support rotor on grease-lubricated ball bearings with extended grease fittings. Mount horizontal wheels on tapered roller bearing.

C. Rotor: Constructed of fluted synthetic fiber-based media impregnated with a non-migrating water selective 4 angstrom molecular sieve desiccant. Construct media for passing maximum 800 micrometer solids and maximum 0.04 percent cross contamination by volume of exhaust air. Drive rotor with belt around outside of rotor.

D. Drive: Fractional horsepower motor and gear reducer

E. Controls: Starting relay, factory mounted and wired, and manual motor starter for field wiring.

F. Controls: Panel factory mounted and wired to motor, with airstream thermostat and adjustable variable-frequency controller for field wiring; with pilot-light indication of rotor rotation and provisions for setting maximum and minimum speed.

G. Changeover Control: Electronic automatic summer changeover system for field mounting of room and outdoor air-temperature sensors, to provide maximum rotor speed when room air temperature is less than outdoor air temperature.

H. Rotation Detection: Electronic control module, electromagnetic sensor, and iron shuttle factory wired and mounted, with alarm bell for field wiring and mounting.

2.3 PACKAGED ENERGY RECOVERY UNITS

A. Manufacturer:

1. Advanced Thermal Technologies.
2. Applied Air; Mestek, Inc.
3. American Energy Exchange.
4. Carnes Company HVAC.
5. Conservation Energy Systems.
6. Des Champs Laboratories Inc.; a unit of Entrodyne Corporation.
7. Engineered Air.
8. Gaylord Industries, Inc.
9. Governaire.
10. Greenheck.
11. Loren Cook Co.
12. Munters; Cargocaire Division.
13. SEMCO Incorporated.
14. Trane Company (The); Worldwide Applied Systems Group.
15. Venmar Ventilation Inc.
16. Wing, L. J.; Mestek, Inc.

B. Housing: Minimum 18 gauge steel with corrosion-protection coating and exterior finish, gasketed and calked weathertight, hinged access doors with neoprene gaskets for inspection and access to internal parts, minimum 1-inch- (25-mm-) thick thermal insulation, knockouts for electrical and piping connections, exterior drain connection, and lifting lugs.

1. Inlet: Duct flanges, with gravity backdraft damper for exhaust and spring-return, two-position, motor-operated damper with blade seals for supply.

C. Energy Recovery Device: See Energy wheel section.

D. Supply and Exhaust Fans: Forward-curved centrifugal fan with spring isolators and flexible duct connections.

1. Motor and Drive: Belt driven with adjustable sheaves, motor mounted on adjustable base.
2. Comply with requirements in Division 15 Section "Motors."

E. Filters: **2-inch- (50-mm-)** thick disposable type, in galvanized steel frame, mounted upstream of unit in both supply and exhaust airstreams.

F. Piping and Wiring: Fabricate units with space within housing for piping and electrical conduits. Wire motors and controls so only external connections are required during installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install heat wheels so supply and exhaust airstreams flow in opposite directions and rotation is from exhaust side to purge section to supply side.

1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to wheel surfaces, drive motor, and seals.
2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
3. Access doors and panels are specified in Division 15 Section "Duct Accessories."

B. Install floor-mounted units on 4-inch- (100-mm-) high concrete base designed to withstand, without damage to equipment, seismic force required by code.

C. Install units with clearances for service and maintenance.

D. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

E. Pipe drains from units and drain pans to nearest floor drain; use **ASTM B 88, Type L (ASTM B 88M, Type B),** drawn-temper copper water tubing with soldered joints same size as condensate drain connection.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Duct and fan installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts, fittings, and specialties.

D. Ground equipment according to Division 16 Section "Grounding and Bonding."

E. 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.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Adjust seals and purge.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Set initial temperature and humidity set points.
5. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 15785

SECTION 15815 - 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 metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2500 Pa). Metal ducts include the following:

1. Rectangular ducts and fittings.
2. Single-wall, round, and flat-oval spiral-seam ducts and formed fittings.
3. Double-wall, round, and flat-oval ducts and formed fittings.

B. Related Sections include the following:
1. Division 15 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
2. Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 DEFINITIONS

A. NUSIG: National Uniform Seismic Installation Guidelines.

1.4 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. 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: CAD-generated and drawn to 1/4 inch equals 1 foot (1:50) or 1/8 inch equals 1 foot (1:100) scale. Show fabrication and installation details for metal ducts.

1. Provide coordination shop drawings as necessary to avoid interferences with the work of other trades.
2. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
3. Duct layout indicating sizes and pressure classes.
4. Elevations of top and bottom of ducts.

5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Duct accessories, including access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Other systems installed in same space as ducts.
3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

C. Welding certificates.

D. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports , and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

C. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to 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, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have paintable finish for surfaces exposed to view.

C. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.

D. Stainless Steel: ASTM A 480/A 480M, Type 316, and having a No. 2D finish for concealed ducts and polished finish for exposed ducts.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 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.

B. Joint and Seam Tape: 2 inches (50 mm) wide; glass-fiber-reinforced fabric.

C. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

D. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

E. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.4 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. 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.
3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

2.5 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying 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 class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Manufacturers:

a. Ductmate Industries, Inc.
b. Nexus Inc.
c. Ward Industries, Inc.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

1. Available Manufacturers:

a. Ductmate Industries, Inc.
b. Lockformer.

2. Duct Size: Maximum 30 inches (750 mm) wide and up to 2-inch wg (500-Pa) pressure class.
3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359 inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of nonbraced panel area unless ducts are lined.

2.6 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round, Spiral Lock Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

C. Flat-Oval, Spiral Lock Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible. Coordinate subparagraph and list below with Part 2 "Manufacturers" Article. Retain "Available" for nonproprietary and delete for semiproprietary specifications.

1. Available Manufacturers:

   a. McGill AirFlow Corporation.
   b. SEMCO Incorporated.

D. Duct Joints:

1. Ducts up to 20 Inches (500 mm) in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
2. Ducts 21 to 72 Inches (535 to 1830 mm) in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
3. Ducts Larger Than 72 Inches (1830 mm) in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

   a. Available Manufacturers:

      1) Ductmate Industries, Inc.
      2) Lindab Inc.

5. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.

   a. Available Manufacturers:

      1) Ductmate Industries, Inc.
      2) McGill AirFlow Corporation.
      3) SEMCO Incorporated.

E. 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 ducts.

F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct 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.
2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg (minus 500 to plus 500 Pa):

    a. Ducts 3 to 36 Inches (75 to 915 mm) in Diameter: 0.034 inch (0.85 mm).
    b. Ducts 37 to 50 Inches (940 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
    c. Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
    d. Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).

3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg (500 to 2500 Pa):

    a. Ducts 3 to 26 Inches (75 to 660 mm) in Diameter: 0.034 inch (0.85 mm).
    b. Ducts 27 to 50 Inches (685 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
    c. Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
    d. Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).

4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
6. Round Elbows 8 Inches (200 mm) and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
7. Round Elbows 9 through 14 Inches (225 through 355 mm) in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
8. Round Elbows Larger Than 14 Inches (355 mm) in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
9. Die-Formed Elbows for Sizes through 8 Inches (200 mm) in Diameter and All Pressures 0.040 inch (1.0 mm) thick with 2-piece welded construction.
10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
11. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
12. Pleated Elbows for Sizes through 14 Inches (355 mm) in Diameter and Pressures through 10-Inch wg (2500 Pa): 0.022 inch (0.55 mm).

2.7 DOUBLE-WALL DUCT AND FITTING FABRICATION

A. Available Manufacturers:

1. Lindab Inc.
2. McGill AirFlow Corporation.
3. SEMCO Incorporated.

B. Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.

1. Outer Shell: Base metal thickness on outer-shell dimensions. Fabricate outer-shell lengths 2 inches (50 mm) longer than inner duct and insulation and in metal thickness specified for single-wall duct.

2. Insulation: 1-inch- (25-mm-) thick fibrous glass, unless otherwise indicated. Terminate insulation where double-wall duct connects to single-wall duct or uninsulated components, and reduce outer shell diameter to inner duct diameter.

   a. Thermal Conductivity (k-Value): 0.26 at 75 deg F (0.037 at 24 deg C) mean temperature.

3. Perforated Inner Ducts: Fabricate with 0.028-inch-0.7-mm- thick sheet metal having 3/32-inch-(2.4-mm-) diameter perforations, with overall open area of 23 percent.
4. Maintain concentricity of inner duct to outer shell by mechanical means. Prevent dislocation of insulation by mechanical means.

C. Fittings: Fabricate double-wall (insulated) fittings with an outer shell and an inner duct.

1. Perforated Inner Ducts: Fabricate with 0.028-inch- (0.7-mm-) thick sheet metal having 3/32-inch-(2.4-mm-) diameter perforations, with overall open area of 23 percent.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
1. Supply Ducts (before Air Terminal Units3-inch wg (750 Pa)].
2. Supply Ducts (after Air Terminal Units): 1-inch wg (250 Pa).
3. Return Ducts (Negative Pressure): 1-inch wg (250 Pa) .
4. Exhaust Ducts (Negative Pressure): 2-inch wg (500 Pa).

B. All ducts shall be galvanized steel except as follows:
1. Range Hood Exhaust Ducts: Comply with NFPA 96.

   a. Concealed: Carbon-steel sheet.
   b. Exposed: Type 304, stainless steel with finish to match kitchen equipment and range hood.
   c. Weld and flange seams and joints.

2. Dishwasher Hood Exhaust Ducts:

   a. Type 304, stainless steel with finish to match kitchen equipment and range hood. Weld and flange seams and joints.

C. Double-wall duct shall be provided according to the following:
1. Exposed, round supply duct (not indicated to be fabric duct).

3.2 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install round and flat-oval ducts in lengths not less than 12 feet (3.7 m) unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches (300 mm), with a minimum of 3 screws in each coupling.

F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches (38 mm).

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."

O. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Refer to SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems," and NUSIG.

P. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

Q. Paint interiors of metal ducts for 24 inches (600 mm) upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.

3.3 RANGE HOOD EXHAUST DUCTS, SPECIAL INSTALLATION REQUIREMENTS

A. Install ducts to allow for thermal expansion through 2000 deg F (1110 deg C) temperature range.

B. Install ducts without dips or traps that may collect residues unless traps have continuous or automatic residue removal.

C. Install access openings at each change in direction and at intervals defined by NFPA 96; locate on sides of duct a minimum of 1-1/2 inches (38 mm) from bottom; and fit with grease-tight covers of same material as duct.

D. Do not penetrate fire-rated assemblies except as permitted by applicable building codes.

3.4 SEAM AND JOINT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.

1. For pressure classes lower than 2-inch wg (500 Pa), seal transverse joints.

B. Seal ducts before external insulation is applied.

3.5 HANGING AND SUPPORTING

A. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

B. Support vertical ducts at maximum intervals of 16 feet (5 m) and at each floor.

C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

D. Install concrete inserts before placing concrete.

E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 15 Section "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes 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.

3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (500 Pa) (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg (500 to 2500 Pa).
4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.8 CLEANING NEW SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

B. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Create other openings to comply with duct standards.
2. Disconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts or duct accessories.
4. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

F. Cleanliness Verification:

1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and reinspect ducts.

3.9 CLEANING EXISTING SYSTEMS

A. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Use existing service openings where possible.
2. Create other openings to comply with duct standards.
3. Disconnect flexible ducts as needed for cleaning and inspection.
4. Reseal rigid fiberglass duct systems according to NAIMA recommended practices.
5. Remove and reinstall ceiling sections to gain access during the cleaning process.

B. Mark position of dampers and air-directional mechanical devices before cleaning, and restore to their marked position on completion.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or larger) particles.
2. When venting vacuuming system to the outside, use filtration to contain debris removed from HVAC system, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts or duct accessories.
4. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
5. Provide operative drainage system for washdown procedures.
6. Biocidal Agents and Coatings: Apply biocidal agents if fungus is present. Apply biocidal agents according to manufacturer's written instructions after removal of surface deposits and debris.

F. Cleanliness Verification:

1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
2. Visually inspect metal ducts for contaminants.
3. Where contaminants are discovered, re-clean and reinspect ducts.

G. Verification of Coil Cleaning: Cleaning must restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be

considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.

END OF SECTION 15815

SECTION 15820 - DUCT ACCESSORIES

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. Backdraft dampers.
2. Volume dampers.
3. Motorized control dampers.
4. Fire dampers.
5. Duct silencers.
6. Turning vanes.
7. Duct-mounting access doors.
8. Flexible connectors.
9. Flexible ducts.

B. Related Sections include the following:

1. Division 13 Section "Fire Alarm" for duct-mounting fire and smoke detectors.
2. Division 15 Section "HVAC Instrumentation and Controls" for electric and pneumatic damper actuators.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Backdraft dampers.
2. Volume dampers.
3. Motorized control dampers.
4. Fire dampers.
5. Duct silencers.
6. Turning vanes.
7. Duct-mounting access doors.
8. Flexible connectors.
9. Flexible ducts.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Special fittings.
2. Manual-volume damper installations.
3. Motorized-control damper installations.

4. Fire-damper, smoke-damper, and combination fire- and smoke-damper installations, including sleeves and duct-mounting access doors.
5. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to 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, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 (Z180) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Stainless Steel: ASTM A 480/A 480M.

D. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063, temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 BACKDRAFT DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. CESCO Products.
4. Duro Dyne Corp.
5. Greenheck.
6. Penn Ventilation Company, Inc.
7. Prefco Products, Inc.
8. Ruskin Company.
9. Vent Products Company, Inc.
10. Arrow

B. Description: Multiple-blade, parallel action gravity balanced, with blades of maximum 6-inch (150-mm) width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.

C. Frame: 0.063-inch- (1.6-mm-) thick extruded aluminum, with welded corners.

D. Blades: 0.025-inch- (0.6-mm-) thick, roll-formed aluminum.

E. Blade Seals: Vinyl.

F. Blade Axles: Nonferrous.

G. Tie Bars and Brackets: Aluminum.

H. Return Spring: Adjustable tension.

2.4 VOLUME DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. Flexmaster U.S.A., Inc.
4. McGill AirFlow Corporation.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Penn Ventilation Company, Inc.
8. Ruskin Company.
9. Vent Products Company, Inc.
10. Arrow.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Pressure Classes of 3-Inch wg (750 Pa) or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized sheet steel.
3. Blade Axles: Galvanized steel.
4. Bearings: Oil-impregnated bronze.
5. Tie Bars and Brackets: Aluminum.
6. Tie Bars and Brackets: Galvanized steel.

D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.5 MOTORIZED CONTROL DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. CESCO Products.
4. Duro Dyne Corp.
5. Greenheck.
6. McGill AirFlow Corporation.
7. METALAIRE, Inc.
8. Nailor Industries Inc.
9. Penn Ventilation Company, Inc.
10. Ruskin Company.
11. Vent Products Company, Inc.
12. Arrow.

B. General Description: AMCA-rated, opposed-blade design; minimum of 0.1084-inch- (2.8-mm-) thick, galvanized-steel frames with holes for duct mounting; minimum of 0.0635-inch- (1.61-mm-) thick, galvanized-steel damper blades with maximum blade width of 8 inches (203 mm).

1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

2.6 FIRE DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. CESCO Products.
3. Greenheck.
4. McGill AirFlow Corporation.

5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Penn Ventilation Company, Inc.
8. Prefco Products, Inc.
9. Ruskin Company.
10. Vent Products Company, Inc.
11. Ward Industries, Inc.

B. Fire dampers shall be labeled according to UL 555.

C. Fire Rating: See drawings for wall rating. Damper rating to match wall rating in accordance with building code.

D. Dynamic Closure Rating: Dampers shall be classified for dynamic closure to 2000 fpm and 4 inches w.g. (1 kPa) static pressure

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.040-inch- (1.02-mm-) thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.040 inch (1.02 mm) thick as indicated and of length to suit application.
2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.028-inch- (0.71-mm-) thick, galvanized sheet steel.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Fusible Links: Replaceable, 165 deg F (74 deg C) rated.

2.7 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- (38-mm-) wide, double-vane, curved blades of galvanized sheet steel set 3/4 inch (19 mm) o.c.; support with bars perpendicular to blades set 2 inches (50 mm) o.c.; and set into vane runners suitable for duct mounting.

1. Available Manufacturers:

a. Ductmate Industries, Inc.
b. Duro Dyne Corp.
c. METALAIRE, Inc.
d. Ward Industries, Inc.

2.8 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.

1. Available Manufacturers:

a. American Warming and Ventilating.
b. CESCO Products.
c. Ductmate Industries, Inc.
d. Flexmaster U.S.A., Inc.
e. Greenheck.
f. McGill AirFlow Corporation.
g. Nailor Industries Inc.
h. Ventfabrics, Inc.
i. Ward Industries, Inc.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Provide number of hinges and locks as follows:

a. Less Than 12 Inches (300 mm) Square: Secure with two sash locks.
b. Up to 18 Inches (450 mm) Square: Two hinges and two sash locks.
c. Up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.
d. Sizes 24 by 48 Inches (600 by 1200 mm) and Larger: One additional hinge.

C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch (25-mm) thickness. Include cam latches.

1. Available Manufacturers:

a. Ductmate Industries, Inc.
b. Flexmaster U.S.A., Inc.

2. Frame: Galvanized sheet steel, with spin-in notched frame.

D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

E. Insulation: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.9 FLEXIBLE CONNECTORS

A. Available Manufacturers:

1. Ductmate Industries, Inc.
2. Duro Dyne Corp.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches (146 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel. Select metal compatible with ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

2.10 FLEXIBLE DUCTS

A. Available Manufacturers:

1. Flexmaster U.S.A., Inc.
2. Hart & Cooley, Inc.
3. McGill AirFlow Corporation.

B. Insulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20.3 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).

C. Flexible Duct Clamps: Nylon strap installed in accordance with insulated duct connector manufacturer's instructions, in sizes 3 through 18 inches (75 to 450 mm) to suit duct size.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.

B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts, and stainless-steel accessories in stainless-steel ducts.

C. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.

F. Install fire dampers, with fusible links, according to manufacturer's UL-approved written instructions.

G. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
1. Downstream from volume dampers, turning vanes, and equipment.
2. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
3. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot (15-m) spacing.
4. On sides of ducts where adequate clearance is available.

H. Label access doors according to Division 15 Section "Mechanical Identification."

I. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

J. Connect terminal units to supply ducts directly. Do not use flexible ducts to change directions.

K. Connect diffusers to low pressure ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place as shown.

L. Connect flexible ducts to metal ducts with draw bands.

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION 15820

SECTION 15838 - POWER VENTILATORS

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. Ceiling-mounting ventilators.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Dampers, including housings, linkages, and operators.
5. Fan speed controllers.

B. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 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.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate installation of equipment supports, and roof/wall penetrations.

PART 2 - PRODUCTS

2.1 CEILING-MOUNTING VENTILATORS

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. Greenheck.
2. Loren Cook Company.
3. Penn Ventilation.

B. Description: Centrifugal fans designed for installing in ceiling or for concealed in-line applications.

C. Housing: Steel, lined with acoustical insulation.

D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

E. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.

F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Isolation: Rubber-in-shear vibration isolators.
3. Manufacturer's standard brick vent and transition fittings.

2.2 CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using elastomeric mounts.

C. Ceiling Units: Suspend units from structure; use steel threaded rod or metal straps.

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Division 15 Section "Mechanical Identification."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 15 Section "Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 16 Section "Grounding and Bonding."

D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Verify lubrication for bearings and other moving parts.
7. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
8. Shut unit down and reconnect automatic temperature-control operators.
9. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust belt tension.

B. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

C. Replace fan and motor pulleys as required to achieve design airflow.

D. Lubricate bearings.

END OF SECTION 15838

SECTION 15855 - 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 10 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 15 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

A. Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

C. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

D. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 GRILLES AND REGISTERS

A. Fixed Face Register AA through FF:

1. Available Manufacturers:

a. Carnes.
b. Price Industries.
c. Titus.

2. Material: Clear anodized aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Frame: 1 inch (25 mm) wide.
5. Mounting: Countersunk screw.

2.3 CEILING DIFFUSER OUTLETS

A. Rectangular and Square Ceiling Diffusers A through E:

1. Available Manufacturers:

a. A-J Manufacturing Co., Inc.
b. Anemostat; a Mestek Company.
c. Carnes.
d. Hart & Cooley, Inc.; Hart & Cooley Div.
e. Krueger.
f. METALAIRE, Inc.; Metal Industries Inc.
g. Nailor Industries of Texas Inc.
h. Price Industries.
i. Titus.
j. Tuttle & Bailey.

2. Material: Steel.
3. Finish: Baked enamel, color selected by Architect.

4. Face Size: 24 by 24 inches (600 by 600 mm) .
5. Face Style: Four cone.
6. Mounting: Surface, and T-bar.
7. Pattern: Fixed.
8. Dampers: Butterfly.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles 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.

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

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

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 ceiling panels, locate units in the center of 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 connections 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.

END OF SECTION 15855

SECTION 15950 - TESTING, ADJUSTING, AND BALANCING

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.

B. Section 15995, HVAC Systems Commissioning, apply to this Section

1.2 SUMMARY

A. This Section includes TAB to produce design objectives for the following:

1. Air Systems:

a. Constant-volume air systems.
b. Variable-air-volume systems.

2. Hydronic Piping Systems:

a. Constant-flow systems.
b. Variable-flow systems.
c. Primary-secondary systems.

3. HVAC equipment quantitative-performance settings.
4. Exhaust hood airflow balancing.
5. Space pressurization testing and adjusting.
6. Vibration measuring.
7. Sound level measuring.
8. Indoor-air quality measuring.
9. Verifying that automatic control devices are functioning properly.
10. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NC: Noise criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.

J. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

K. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

L. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

M. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

N. TAB: Testing, adjusting, and balancing.

O. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

P. Test: A procedure to determine quantitative performance of systems or equipment.

Q. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 45 days from Contractor's Notice to Proceed, submit 4 copies of the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 4 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

E. Sample Report Forms: Submit two sets of sample TAB report forms.

F. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

a. Submittal distribution requirements.
b. The Contract Documents examination report.
c. TAB plan.
d. Work schedule and Project-site access requirements.
e. Coordination and cooperation of trades and subcontractors.
f. Coordination of documentation and communication flow.

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems", NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" or TAB firm's forms approved by Architect.

E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 PROJECT CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

A. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

M. Examine strainers for clean screens and proper perforations.

N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

P. Examine system pumps to ensure absence of entrained air in the suction piping.

Q. Examine equipment for installation and for properly operating safety interlocks and controls.

R. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.

7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems", NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME GEOTHERMAL HEAT PUMP SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
b. Measure static pressure directly at the fan outlet or through the flexible connection.
c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.7 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Check main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.8 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to minus 10 percent.

3. Heating-Water Flow Rate: 0 to minus 10 percent.
4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.9 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.10 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of TAB firm.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.

c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches (mm), and bore.
    i. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
    j. Number of belts, make, and size.
    k. Number of filters, type, and size.

2. Motor Data:

    a. Make and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches (mm), and bore.
    f. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).

3. Test Data (Indicated and Actual Values):

    a. Total airflow rate in cfm (L/s).

b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Filter static-pressure differential in inches wg (Pa).
f. Preheat coil static-pressure differential in inches wg (Pa).
g. Cooling coil static-pressure differential in inches wg (Pa).
h. Heating coil static-pressure differential in inches wg (Pa).
i. Outside airflow in cfm (L/s).
j. Return airflow in cfm (L/s).
k. Outside-air damper position.
l. Return-air damper position.
m. Vortex damper position.

G. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch (mm) o.c.
f. Make and model number.
g. Face area in sq. ft. (sq. m).
h. Tube size in NPS (DN).
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm (L/s).
b. Average face velocity in fpm (m/s).
c. Air pressure drop in inches wg (Pa).
d. Outside-air, wet- and dry-bulb temperatures in deg F (deg C).
e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
h. Water flow rate in gpm (L/s).
i. Water pressure differential in feet of head or psig (kPa).
j. Entering-water temperature in deg F (deg C).
k. Leaving-water temperature in deg F (deg C).
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig (kPa).
n. Refrigerant suction temperature in deg F (deg C).
o. Inlet steam pressure in psig (kPa).

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.

f. Arrangement and class.
g. Sheave make, size in inches (mm), and bore.
h. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).

2. Motor Data:

a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
g. Number of belts, make, and size.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Suction static pressure in inches wg (Pa).

I. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Unit make and model number.
d. Compressor make.
e. Compressor model and serial numbers.
f. Refrigerant weight in lb (kg).
g. Low ambient temperature cutoff in deg F (deg C).

2. Test Data (Indicated and Actual Values):

a. Inlet-duct static pressure in inches wg (Pa).
b. Outlet-duct static pressure in inches wg (Pa).
c. Entering-air, dry-bulb temperature in deg F (deg C).
d. Leaving-air, dry-bulb temperature in deg F (deg C).
e. Condenser entering-water temperature in deg F (deg C).
f. Condenser leaving-water temperature in deg F (deg C).
g. Condenser-water temperature differential in deg F (deg C).
h. Condenser entering-water pressure in feet of head or psig (kPa).
i. Condenser leaving-water pressure in feet of head or psig (kPa).
j. Condenser-water pressure differential in feet of head or psig (kPa).
k. Control settings.
l. Unloader set points.
m. Low-pressure-cutout set point in psig (kPa).
n. High-pressure-cutout set point in psig (kPa).
o. Suction pressure in psig (kPa).
p. Suction temperature in deg F (deg C).
q. Condenser refrigerant pressure in psig (kPa).
r. Condenser refrigerant temperature in deg F (deg C).

s. Oil pressure in psig (kPa).
t. Oil temperature in deg F (deg C).
u. Voltage at each connection.
v. Amperage for each phase.
w. Kilowatt input.
x. Crankcase heater kilowatt.
y. Number of fans.
z. Condenser fan rpm.
aa. Condenser fan airflow rate in cfm (L/s).
bb. Condenser fan motor make, frame size, rpm, and horsepower.
cc. Condenser fan motor voltage at each connection.
dd. Condenser fan motor amperage for each phase.

J. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model and serial numbers.
f. Water flow rate in gpm (L/s).
g. Water pressure differential in feet of head or psig (kPa).
h. Required net positive suction head in feet of head or psig (kPa).
i. Pump rpm.
j. Impeller diameter in inches (mm).
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig (kPa).
b. Pump shutoff pressure in feet of head or psig (kPa).
c. Actual impeller size in inches (mm).
d. Full-open flow rate in gpm (L/s).
e. Full-open pressure in feet of head or psig (kPa).
f. Final discharge pressure in feet of head or psig (kPa).
g. Final suction pressure in feet of head or psig (kPa).
h. Final total pressure in feet of head or psig (kPa).
i. Final water flow rate in gpm (L/s).
j. Voltage at each connection.
k. Amperage for each phase.

K. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.

c. Application.
d. Dates of use.
e. Dates of calibration.

3.11 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.
b. Measure water flow of at least 5 percent of terminals.
c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Measure sound levels at two locations.
e. Measure space pressure of at least 10 percent of locations.
f. Verify that balancing devices are marked with final balance position.
g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection and Verification:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner's representative.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner's representative.
3. Owner's representative shall perform 100% verification of all measurements documented in the final report. See section 15995 – HVAC Systems Commissioning for requirements.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.12 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 15950

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SECTION 15140 - 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 domestic water piping inside the building.

B. Water meters will be furnished and installed by utility company.

C. Related Sections include the following:

1. Division 2 Section "Water Distribution" for water-service piping outside the building from source to the point where water-service piping enters the building.
2. Division 15 Section "Meters and Gages" for thermometers, pressure gages, and fittings.
3. Division 15 Section "Plumbing Specialties" for water distribution piping specialties.

1.3 DEFINITIONS

A. CPVC: Chlorinated polyvinyl chloride plastic.

B. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with 125 psig (860 kPa) unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Water Samples: Specified in Part 3 "Cleaning" Article.

C. Field quality-control test reports.

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 System Components and Related Materials," for plastic, potable domestic water piping and components.

C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.

B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Schedule 40, galvanized. Include ends matching joining method.

   1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
   2. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body, with ball-and-socket, metal-to-metal, bronze seating surface and female threaded ends.
   3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
   4. Cast-Iron Flanges: ASME B16.1, Class 125.
   5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.
   6. Steel-Piping, Grooved-End Fittings: ASTM A 47/A 47M, galvanized, malleable-iron casting; ASTM A 106, galvanized steel pipe; or ASTM A 536, galvanized, ductile-iron casting; with dimensions matching steel pipe.

      a. Grooved-End-Pipe Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

   7. Steel-Piping, Expansion Joints: Compound, galvanized steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.
   8. Steel-Piping, Double Expansion Joints: Compound, galvanized steel fitting with telescoping body and two slip-pipe sections. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.

2.4 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Types K and L (ASTM B 88M, Types A and B), water tube, annealed 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 ends. 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.

B. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), 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 ends. 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.
4. Copper, Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.

a. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.

2.5 VALVES

A. Bronze and cast-iron, general-duty valves are specified in Division 15 Section "Valves."

B. Balancing and drain valves are specified in Division 15 Section "Plumbing Specialties."

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 PIPE AND FITTING 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. Flanges may be used on aboveground piping, unless otherwise indicated.

C. Grooved joints may be used on aboveground grooved-end piping.

D. Under-Building-Slab, Water-Service Piping on Service Side of Water Meter: Refer to Division 2 Section "Water Distribution."

E. Domestic Water Piping on Service Side of Water Meter inside the Building: Use any of the following piping materials for each size range:

1. NPS 4 to NPS 6 (DN 100 to DN 150): Steel pipe; gray-iron, threaded fittings; and threaded joints.
2. NPS 4 to NPS 6 (DN 100 to DN 150): Steel pipe with grooved ends; steel-piping, grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
3. NPS 4 to NPS 6 (DN 100 to DN 150): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
4. NPS 4 to NPS 6 (DN 100 to DN 150): Hard copper tube, Type L (Type B) with grooved ends; copper grooved-end fittings; grooved-end-tube couplings; and grooved joints.

F. Under-Building-Slab, Domestic Water Piping on House Side of Water Meter, NPS 4 (DN 100) and Smaller: Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.

G. Aboveground Domestic Water Piping: Use any of the following piping materials for each size range:

1. NPS 1 (DN 25) and Smaller: Hard copper tube, Type L (Type B) or Type M (Type C); copper pressure fittings; and soldered joints.
2. NPS 1-1/4 and NPS 1-1/2 (DN 32 and DN 40): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
3. NPS 2 (DN 50): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
4. NPS 2 (DN 50): Hard copper tube, Type L (Type B) with grooved ends; copper grooved-end fittings; grooved-end-tube couplings; and grooved joints.
5. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
6. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Hard copper tube, Type L (Type B) with grooved ends; copper grooved-end fittings; grooved-end-tube couplings; and grooved joints.
7. NPS 4 to NPS 6 (DN 100 to DN 150): Steel pipe; gray-iron, threaded fittings; and threaded joints.
8. NPS 4 to NPS 6 (DN 100 to DN 150): Steel pipe with grooved ends; steel-piping, grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
9. NPS 4 to NPS 6 (DN 100 to DN 150): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
10. NPS 4 to NPS 6 (DN 100 to DN 150): Hard copper tube, Type L (Type B) with grooved ends; copper grooved-end fittings; grooved-end-tube couplings; and grooved joints.

3.3 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 or gate valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.

2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
3. Hot-Water-Piping, Balancing Duty: Memory-stop balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Cast-iron, grooved-end valves may be used with grooved-end piping.

C. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.

D. 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.

E. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 (DN 50) and smaller and butterfly valves for piping NPS 2-1/2 (DN 65) and larger. Balancing valves are specified in Division 15 Section "Plumbing Specialties."

3.4 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."

C. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 15 Section "Basic Mechanical Materials and Methods."

D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Pressure gages are specified in Division 15 Section "Meters and Gages," and drain valves and strainers are specified in Division 15 Section "Plumbing Specialties."

E. Install water-pressure regulators downstream from shutoff valves. Water-pressure regulators are specified in Division 15 Section "Plumbing Specialties."

F. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

3.5 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

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.

3.6 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

B. Pipe hanger and support devices are specified in Division 15 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet (30 m): MSS Type 49, spring cushion rolls, if indicated.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 15 Section "Hangers and Supports."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch (10 mm).

F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.

G. Install supports for vertical steel piping every 15 feet (4.5 m).

H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.

I. Install supports for vertical copper tubing every 10 feet (3 m).

J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

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 water-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 (DN 65) 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 has been inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

      a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

   3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
   4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:

   1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test

source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 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.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 15140

SECTION 15150 - 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 the following for soil, waste, storm, and vent piping inside the building:

1. Pipe, tube, and fittings.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Field quality-control inspection and test reports.

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

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil, waste, storm and vent piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Aboveground, soil, waste, storm and vent piping NPS 5 (DN 125) and larger shall be any of the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Underground, soil, waste, storm and vent piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

E. Underground, soil, waste and storm piping NPS 5 (DN 125) and larger shall be any of the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.3 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified in Division 2 Section "Sanitary Sewerage."

B. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 15 Section "Basic Mechanical Materials and Methods."

E. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

F. 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.

G. 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.

H. Install soil, storm 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 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) 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.

I. Install engineered storm, soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.

J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:

   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 15 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

E. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and 5 (DN 100 and 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

F. Install supports for vertical PVC piping every 48 inches (1200 mm).

G. 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 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. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

3.7 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.
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 (30 kPa). 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 (250 Pa). 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.

3.8 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.

3.9 PROTECTION

A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 15150

SECTION 15160 - 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 the following storm drainage piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

E. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water (30 kPa).

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Field quality-control inspection and test reports.

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-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to 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, manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

2.4 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

a. Dallas Specialty & Mfg. Co.
b. Fernco, Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Co.
e. NDS, Inc.
f. Plastic Oddities, Inc.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground storm drainage piping shall be the following:
1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Underground storm drainage piping shall be the following:
1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.3 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 2 Section "Storm Drainage."

B. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 15 Section "Plumbing Specialties."

D. Install wall-penetration fitting system at each service pipe penetration through foundation wall. Make installation watertight.

E. Make changes in direction for storm 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.

F. Lay buried building drain 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.

G. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:

1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

H. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

I. Install PVC storm drainage piping according to ASTM D 2665.

J. Install underground PVC storm drainage piping according to ASTM D 2321.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 15 Section "Hangers and Supports."

C. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

D. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

E. Install supports for vertical PVC piping every 48 inches (1200 mm).

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.

3.7 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 (30 kPa). From 15 minutes before inspection starts to 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.

3.8 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.

END OF SECTION 15160

SECTION 15410 - 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 the following conventional plumbing fixtures and related components:

1. Faucets for lavatories and sinks.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Interceptors.
7. Water closets.
8. Urinals.
9. Lavatories.
10. Commercial sinks.
11. Kitchen sinks.
12. Service sinks.
13. Service basins.

B. Related Sections include the following:

1. Division 2 Section "Water Distribution" for exterior plumbing fixtures and hydrants.
2. Division 10 Section "Toilet and Bath Accessories."
3. Division 15 Section "Emergency Plumbing Fixtures."
4. Division 15 Section "Drinking Fountains and Water Coolers."
5. Division 15 Section "Plumbing Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the 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.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

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.

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"; for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.

2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
3. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
4. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
5. Stainless-Steel Residential Sinks: ASME A112.19.3.
6. Vitreous-China Fixtures: ASME A112.19.2M.
7. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
1. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
2. Faucets: ASME A112.18.1.
3. Hose-Connection Vacuum Breakers: ASSE 1011.
4. Hose-Coupling Threads: ASME B1.20.7.
5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
6. NSF Potable-Water Materials: NSF 61.
7. Pipe Threads: ASME B1.20.1.
8. Supply Fittings: ASME A112.18.1.
9. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for shower faucets:

1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
3. Faucets: ASME A112.18.1.
4. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
5. Hose-Coupling Threads: ASME B1.20.7.
6. Manual-Control Antiscald Faucets: ASTM F 444.
7. Pipe Threads: ASME B1.20.1.
8. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
9. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

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 A112.18.1.
3. Manual-Operation Flushometers: ASSE 1037.
4. Plastic Tubular Fittings: ASTM F 409.
5. Brass Waste Fittings: ASME A112.18.2.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Flexible Water Connectors: ASME A112.18.6.
2. Floor Drains: ASME A112.6.3.
3. Grab Bars: ASTM F 446.
4. Hose-Coupling Threads: ASME B1.20.7.
5. Off-Floor Fixture Supports: ASME A112.6.1M.
6. Pipe Threads: ASME B1.20.1.
7. Plastic Toilet Seats: ANSI Z124.5.
8. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures of unit shell.
b. Faulty operation of controls, blowers, pumps, heaters, and timers.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period for Commercial Applications: Three year(s) from date of Substantial Completion.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Toilet Seats: Equal to 5 percent of amount of each type installed.
6. Dry Urinal Trap-Seal Cartridges: Equal to 200 percent of amount of each type installed, but no fewer than 12 of each type.
7. Dry Urinal Trap-Seal Liquid: Equal to 1 gal (3.8 L) for each urinal installed.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCET EXPRESS SYSTEMS

A. Lavatory Faucet Systems:

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 following:

a. Bradley Corporation; Model – MG-2/IR-NSD-TMA
b. Kohler Co.
c. Zurn Plumbing Products Group; Commercial Brass Operation.
d. American Standard Companies, Inc.

2. Description: A molded solid surface sprayhead that is an integral part of the bowl module. A free spinning collar to protect the aerator from vandalism. An infrared sensor will automatically shut off water flow. All models shall be similar to Bradley MG-Series (Infrared Control), no soap dispenser, and thermostatic mixing assembly – hot and cold water supplies. Standard Equipment shall include: continuous bowl with two lavatories, sprayhead, pedestal, stainless steel mounting frame, 110/24 VAC plug-in transformer. The following fittings shall be provided: P-trap; tailpiece; two flexible stainless steel supply connections; and thermostatic mixing valve with combination stop, strainer, and check valves.

a. Model:
b. Body Material: Commercial, solid brass.
c. Finish: Polished chrome plate.
d. Maximum Flow Rate: 2.2 gpm (8.3 L/min.).
e. Maximum Flow: 0.25 gal. (0.95 L).
f. Centers: 4 inches (102 mm) Single hole.
g. Mounting: Deck, exposed.
h. Valve Handle(s): Blade Type (side to side).
i. Inlet(s): NPS 3/8 (DN 10) tubing, with NPS 1/2 (DN 15) male adaptor.
j. Spout: Rigid type.
k. Spout Outlet: Aerator.
l. Operation: manual.
m. Drain: Grid.
n. Tempering Device: Not required.

2.2 SINK FAUCETS

A. Sink Faucets:

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 following:

a. Bradley Corporation
b. Elkay
c. Kohler Co.
d. American Standard Companies, Inc.

2. Description: Kitchen faucet without spray, Laundry tray faucet, Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

a. Model: Elkay LK-2439-BH, Elkay LK-2325-BH, Elkay LK-2423-BH, Chicago 897RCF, Elkay LK-2423-BH.
b. Body Material: Commercial, solid brass.
c. Finish: Polished chrome plate.
d. Maximum Flow Rate: 2.5 gpm (9.5 L/min.), unless otherwise indicated.
e. Mixing Valve: Two-lever handle.
f. Backflow Protection Device for Side Spray: Not required.
g. Centers: 4 inches
h. Mounting: Deck.
i. Handle(s): Wrist blade, 4 inches (102 mm.
j. Inlet(s): NPS 3/8 (DN 10) tubing with NPS 1/2 (DN 15) male adapter.
k. Spout Type: Swivel gooseneck.
l. Spout Outlet: Aerator.
m. Vacuum Breaker: Required.
n. Operation: Noncompression, manual.
o. Drain: Grid.

2.3 FLUSHOMETERS

A. Flushometers:

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 following:
   a. Hydrotek International, Inc.
   b. Sloan Valve Company.
   c. Zurn Plumbing Products Group; Commercial Brass Operation.

2. Description: Flushometer for [urinal] [water-closet]-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

   a. Internal Design: Diaphragm operation.
   b. Style: Exposed.
   c. Inlet Size: [NPS 3/4 (DN 20) Urinal] [NPS 1 (DN 25) Water Closet].
   d. Trip Mechanism: Oscillating, lever-handle actuator
   e. Consumption: 1.0 gal./flush (3.8 L/flush) Urinal, 1.6 gal./flush (6.0 L/flush)Water Closet
   f. Tailpiece Size: [NPS 3/4 (DN 20) Urinal] [NPS 1 (DN 25) Water Closet] and standard length to top of bowl.

2.4 TOILET SEATS

A. Toilet Seats:

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 following:
   a. Bemis Manufacturing Company.
   b. Church Seats.
   c. Kohler Co.

2. Description: Toilet seat for water-closet-type fixture.

   a. Material: Molded, solid plastic with antimicrobial agent.
   b. Configuration: Open front without cover.
   c. Size: Elongated.
   d. Hinge Type: SC, self-sustaining, check.
   e. Class: Heavy-duty commercial.
   f. Color: White.

2.5 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:

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 following:

   a. Engineered Brass Co.
   b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
   c. McGuire Manufacturing Co., Inc.
   d. Plumberex Specialty Products Inc.
   e. TCI Products.
   f. TRUEBRO, Inc.
   g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures,

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 following:

a. TRUEBRO, Inc.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.6 FIXTURE SUPPORTS

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. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Urinal Supports:

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

C. Lavatory Supports:

1. Description: III, lavatory carrier with hanger plate and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

2.7 WATER CLOSETS

A. Water Closets:

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 following:
   a. American Standard Companies, Inc.
   b. Eljer.
   c. Kohler Co.

2. Description: [Accessible, floor] [Floor]-wall hung, vitreous-china fixture designed for flushometer valve operation.
   a. Style: Flushometer valve.

1) Model: American Standard-Afwall
2) Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
3) Height: [Standard P-1] [Accessible].
4) Design Consumption: 1.6 gal./flush (6 L/flush).
5) Color: White.

2.8 URINALS

A. Urinals:

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 following:

   a. American Standard Companies, Inc.
   b. Eljer.
   c. Kohler Co.

2. Description: [Accessible, wall] [Wall]-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.

   a. Model: American Standard-Washbrook
   b. Type: Siphon jet.
   c. Strainer or Trapway: Open trapway with integral trap.
   d. Design Consumption: 1 gal./flush (3.8 L/flush)
   e. Color: White.
   f. Supply Spud Size: NPS 3/4 (DN 20).
   g. Outlet Size: NPS 2 (DN 50).

2.9 LAVATORIES

A. Lavatories:

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 following:

   a. American Standard Companies, Inc.
   b. Eljer.
   c. Kohler Co.

2. Description: Accessible, wall-mounting, enameled, cast-iron fixture.

   a. Model: Eljer 052-0174.
   b. Type: With back.
   c. Size: 20 by 18 inches (508 by 457 mm) rectangular.
   d. Faucet Hole Punching: Three holes, 4-inch (102-mm) centers.
   e. Faucet Hole Location: Top.
   f. Color: White.
   g. Supplies: NPS 3/8 (DN 10) chrome-plated copper with stops.
   h. Drain: Grid.
   i. Drain Piping: Schedule 40 ABS or PVC, NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40) P-trap; NPS 1-1/2 (DN 40), tubular waste to wall; and wall escutcheon.

2.10 COMMERCIAL SINKS

A. Commercial Sinks:

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 following:

a. Advance Tabco.
b. Elkay Manufacturing Co.
c. Just Manufacturing Company.
d. Metal Masters Foodservice Equipment Co., Inc.

2. Description: [One] [Two] compartment, counter-mounting, stainless-steel commercial sink.

a. Model:
1) Elkay LRAD-2222-5-3.
2) Elkay LRAD-2219
3) Elkay LRAD-2222-5-3
4) Elkay LR-1716
5) Elkay LRAD-1716
6) Fiat FL-1
7) Elkay EWS3120W6C

b. Supplies: NPS 1/2 (DN 15) chrome-plated copper with stops or shutoff valves.
c. Drain Piping: NPS 2 (DN 50) chrome-plated, cast-brass P-trap; copper pipe waste to wall; continuous waste; and wall escutcheon(s).
d. Drain: Location near back of compartment (ADA)
e. Plaster Traps: Equivalent to Zurn Z-1180.

2.11 SERVICE SINKS

1. Available Manufacturures: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Stern Williams

b. Florestone

c. Acorn Engineering Co.

3. Description:

a. Model:
1) Zurn

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb according to roughing-in drawings.

I. 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 valves if supply stops are not specified with fixture. Valves are specified in Division 15 Section "Valves."

J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

L. 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.

M. Install toilet seats on water closets.

N. Install trap-seal liquid in dry urinals.

O. 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.

P. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

Q. 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.

R. Install shower flow-control fittings with specified maximum flow rates in shower arms.

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 each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

U. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install on countertop at sink. Connect inlet hose to dishwasher and outlet hose to disposer.

V. 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. Escutcheons are specified in Division 15 Section "Basic Mechanical Materials and Methods."

W. Set shower receptors and service basins in leveling bed of cement grout. Grout is specified in Division 15 Section "Basic Mechanical Materials and Methods."

X. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

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 fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 16 Section "Grounding and Bonding."

D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing 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. 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.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 15410

SECTION 15415 - DRINKING FOUNTAINS AND WATER COOLERS

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 water coolers and related components:
   1. Water coolers.
   2. Fixture supports.

1.3 DEFINITIONS

A. Accessible Water Cooler: Fixture that can be approached and used by people with disabilities.

B. Fitting: Device that controls flow of water into or out of fixture.

C. Fixture: Drinking fountain or water cooler unless one is specifically indicated.

D. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.5 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.

B. 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"; for fixtures for people with disabilities.

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.

E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filter Cartridges: Equal to 200 percent of amount installed for each type and size indicated.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

A. Water Coolers:

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

a. Sunroc Corp.
b. Oasis Corporation.
c. Haws Corporation.

2. Description: Accessible, ARI 1010, Type PB, pressure with bubbler, Style W, wall-mounting water cooler for adult mounting height. Sunroc is on state contract—use as example.

a. Model: Elkay EZS8, EZSTL8C
b. Cabinet: Single, Bilevel with two attached cabinets and with bilevel skirt kit, vinyl-covered steel with stainless-steel top.
c. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
d. Control: Push bar.
e. Supply: NPS 3/8 (DN 10) with ball, gate, or globe valve.
f. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
g. Drain(s): Grid with NPS 1-1/4 (DN 32) minimum horizontal waste and trap complying with ASME A112.18.1.
h. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.

1) Capacity: 8 gph (0.0084 L/s) of 50 deg F (10 deg C) cooled water from 80 deg F (27 deg C) inlet water and 90 deg F (32 deg C) ambient air temperature.
2) Electrical Characteristics: 120-V ac; single phase; 60 Hz.

i. Support: Type II, water cooler carrier. Refer to "Fixture Supports" Article.

2.2 FIXTURE SUPPORTS

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. Josam Co.
2. MIFAB Manufacturing, Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.
7. Wade.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

1. Type I: Hanger-type carrier with two vertical uprights.
2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.

B. Examine walls and floors for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 15 Section "Valves."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 15 Section "Basic Mechanical Materials and Methods."

G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 16 Section "Grounding and Bonding."

D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

1. Remove and replace malfunctioning units and retest as specified above.
2. Report test results in writing.

3.6 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water cooler temperature settings.

3.7 CLEANING

A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 15415

SECTION 15430 - PLUMBING SPECIALTIES

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 plumbing specialties:

1. Backflow preventers.
2. Water regulators.
3. Balancing valves.
4. Thermostatic water mixing valves.
5. Water tempering valves.
6. Strainers.
7. Outlet boxes.
8. Hose stations.
9. Key-operation hydrants.
10. Wheel-handle wall hydrants.
11. Trap seal primer valves.
12. Drain valves.
13. Backwater valves.
14. Miscellaneous piping specialties.
15. Sleeve penetration systems.
16. Flashing materials.
17. Cleanouts.
18. Floor drains.
19. Roof drains.
20. Overflow drains.

B. Related Sections include the following:

1. Division 15 Section "Meters and Gages" for water meters, thermometers, and pressure gages.

1.3 DEFINITIONS

A. The following are industry abbreviations for plastic piping materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. PE: Polyethylene plastic.
3. PUR: Polyurethane plastic.
4. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:

1. Domestic Water Piping: 125 psig (860 kPa).
2. Sanitary Waste and Vent Piping: 10-foot head of water (30 kPa).

1.5 SUBMITTALS

A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:

1. Backflow preventers and water regulators.
2. Balancing valves, water filters, and strainers.
3. Thermostatic water mixing valves and water tempering valves.
4. Water hammer arresters, air vents, and trap seal primer valves and systems.
5. Drain valves, hose bibbs, hydrants, and hose stations.
6. Outlet boxes and washer-supply outlets.
7. Backwater valves, cleanouts, floor drains, open receptors, trench drains, and roof drains.
8. Air-admittance valves, vent caps, vent terminals, and roof flashing assemblies.
9. Sleeve penetration systems.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field test reports.

D. Maintenance Data: For plumbing specialties to include in maintenance manuals. Include the following:

1. Backflow preventers and water regulators.
2. Thermostatic water mixing valves and water tempering valves.
3. Trap seal primer valves and systems.
4. Hose stations and hydrants.

1.6 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of plumbing specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

B. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.

C. 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.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.

E. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping.
2. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Water Filter Cartridges: Equal to 200 percent of amount installed for each type and size indicated.
2. Operating Key Handles: Equal to 100 percent of amount installed for each key-operated hose bibb and hydrant installed.

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.

2.2 BACKFLOW PREVENTERS

A. Available Manufacturers:

B. Manufacturers:

1. B & K Industries, Inc.
2. Zurn Industries, Inc.; Wilkins Div.
3. CMB Industries, Inc.; Febco Backflow Preventers.
4. Watts Industries, Inc.; Water Products Div.

C. General: ASSE standard, backflow preventers.

1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
2. NPS 2-1/2 (DN 65) and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.

a. Interior Lining: AWWA C550 or FDA-approved, epoxy coating for backflow preventers having cast-iron or steel body.

3. Interior Components: Corrosion-resistant materials.
4. Strainer: On inlet, if indicated.

D. Hose-Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7, garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.

E. Reduced-Pressure-Principle Backflow Preventers: ASSE 1013, suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet; test cocks; and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between two positive-seating check valves.

1. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.

F. Laboratory Faucet Vacuum Breakers: ASSE 1035, suitable for continuous pressure application and chrome plated; consisting of primary and secondary checks; intermediate vacuum breaker; and threaded ends, NPS 1/4 or NPS 3/8 (DN 8 or DN 10) as required.

G. Hose-Connection Backflow Preventers: ASSE 1052, suitable for at least 3-gpm (0.19-L/s) flow and applications with up to 10-foot head of water (30-kPa) back pressure. Include two check valves; intermediate atmospheric vent; and nonremovable, ASME B1.20.7, garden-hose threads on outlet.

2.3 WATER REGULATORS

A. Available Manufacturers:

1. FLOMATIC Corp.
2. Watts Industries, Inc.; Water Products Div.
3. Zurn Industries, Inc.; Wilkins Div.

B. General: ASSE 1003, water regulators, rated for initial working pressure of 150 psig (1035 kPa) minimum. Include integral factory-installed or separate field-installed, Y-pattern strainer.

1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.

a. General-Duty Service: Single-seated, direct operated, unless otherwise indicated.
b. Booster Heater Water Supply: Single-seated, direct operated with integral bypass.

2. NPS 2-1/2 (DN 65) and Larger: Bronze or cast-iron body with flanged ends. Include AWWA C550 or FDA-approved, interior epoxy coating for regulators with cast-iron body.

a. Type: Single-seated, direct operated.
b. Type: Pilot-operated, single- or double-seated, cast-iron-body main valve, with bronze-body pilot valve.

3. Interior Components: Corrosion-resistant materials.
4. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.

2.4 BALANCING VALVES

A. Memory-Stop Balancing Valves, NPS 2 (DN 50) and Smaller: MSS SP-110, ball valve, rated for 400-psig (2760-kPa) minimum CWP. Include two-piece, copper-alloy body with standard or full-port, chrome-plated brass ball, replaceable seats and seals, threaded or solder-joint ends, and vinyl-covered steel handle with memory-stop device.

1. Available Manufacturers:

a. Grinnell Corporation.
b. Milwaukee Valve Company.

c. NIBCO INC.
d. Red-White Valve Corp.

2.5 THERMOSTATIC WATER MIXING VALVES

A. Available Manufacturers:

1. Lawler Manufacturing Company, Inc. Model 802
2. Mark Controls Corp.; Powers Process Controls.
3. T & S Brass and Bronze Works, Inc.

B. General: ASSE 1017, manually adjustable, thermostatic water mixing valve with bronze body. Include check stop and union on hot- and cold-water-supply inlets, adjustable temperature setting, and thermometer.

1. Type: Bimetal thermostat, operation and pressure rating 125 psig (860 kPa) minimum.
2. Type: Liquid-filled motor, operation and pressure rating 100 psig (690 kPa) minimum.

C. Thermostatic Water Mixing Valves: Unit, with the following:

1. Piping, valves, and unions. Include thermometer.
2. Piping Component Finish: Rough bronze.

2.6 WATER TEMPERING VALVES

A. Available Manufacturers:

B. Manufacturers:

1. Holby Valve Co., Inc.
2. Sparco, Inc.
3. Watts Industries, Inc.; Water Products Div.

C. General: Manually adjustable, thermostatically controlled water tempering valve; bronze body; and adjustable temperature setting.

D. System Water Tempering Valves: Piston or discs controlling both hot- and cold-water flow, capable of limited antiscald protection. Include threaded inlets and outlet.

1. Finish: Chrome plated.

E. Limited-Volume, Water Tempering Valves: Solder-joint inlets and NPS 3/4 (DN 20) maximum outlet.

2.7 STRAINERS

A. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 3/64-inch (1.2-mm) round perforations, unless otherwise indicated.

1. Pressure Rating: 125-psig (860-kPa) minimum steam working pressure, unless otherwise indicated.

2. NPS 2 (DN 50) and Smaller: Bronze body, with female threaded ends.
3. NPS 2-1/2 (DN 65) and Larger: Cast-iron body, with interior AWWA C550 or FDA-approved, epoxy coating and flanged ends.
4. Y-Pattern Strainers: Screwed screen retainer with centered blowdown.

   a. Drain: Factory- or field-installed, hose-end drain valve.

2.8 OUTLET BOXES

A. Manufacturers:

1. Acorn Engineering Company.
2. Oatey.
3. Zurn Industries, Inc.; Jonespec Div.

B. General: Recessed-mounting outlet boxes with supply fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections, and wood-blocking reinforcement.

C. Icemaker Outlet Boxes: With hose connection and the following: Guy Gray BIM875

1. Box and Faceplate: Stainless steel.
2. Shutoff Fitting: Hose bibb.
3. Supply Fitting: NPS 1/2 (DN 15) gate, globe, or ball valve and NPS 1/2 (DN 15) copper, water tubing.

2.9 KEY-OPERATION HYDRANTS

A. Manufacturers:

1. Josam Co.
2. Smith, Jay R. Mfg. Co.
3. Watts Industries, Inc.; Drainage Products Div.
4. Zurn Industries, Inc.; Jonespec Div.

B. General: ASME A112.21.3M, key-operation hydrant with pressure rating of 125 psig (860 kPa). Woodford 24.

1. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25) threaded or solder joint.
2. Outlet: ASME B1.20.7, garden-hose threads.
3. Operating Keys: Two with each key-operation hydrant.

C. Nonfreeze Concealed-Outlet Wall Hydrants: ASSE 1019, self-drainable with flush-mounting box with cover, integral nonremovable hose-connection vacuum breaker, casing and operating rod to match wall thickness, concealed outlet, and wall clamp. Woodford B24.

1. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
2. Box and Cover Finish: Polished nickel bronze.
3. Box and Cover Finish: Satin chrome plate.

D. Anti-freeze Concealed – Outlet Wall Hydrant automatic draining, freezeless wall hydrants with anti-siphon vacuum breakers. Woodford B65.

2.10 TRAP SEAL PRIMER VALVES

A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:

1. Available Manufacturers:

   a. Josam Co.
   b. Precision Plumbing Products, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Tyler Pipe; Wade Div.
   e. Watts Industries, Inc.; Water Products Div.
   f. Zurn Industries, Inc.; Jonespec Div.

2. 125-psig (860-kPa) minimum working pressure.
3. Bronze body with atmospheric-vented drain chamber.
4. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.11 DRAIN VALVES

A. Hose-End Drain Valves: MSS SP-110, NPS 3/4 (DN 20) ball valve, rated for 400-psig (2760-kPa) minimum CWP. Include two-piece, copper-alloy body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, and vinyl-covered steel handle.

1. Inlet: Threaded or solder joint.
2. Outlet: Short-threaded nipple with ASME B1.20.7, garden-hose threads and cap.

2.12 MISCELLANEOUS PIPING SPECIALTIES

A. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, metal-bellows type with pressurized metal cushioning chamber. Sizes indicated are based on ASSE 1010 or PDI-WH 201, Sizes A through F.

1. Available Manufacturers:

   a. Josam Co.
   b. Smith, Jay R. Mfg. Co.
   c. Zurn Industries, Inc.; Specification Drainage Operation.

B. Hose Bibbs: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compression-type faucets. Include NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet, of design suitable for pressure of at least 125 psig (860 kPa); integral nonremovable, drainable hose-connection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.

1. Finish for Equipment Rooms: Rough bronze.
2. Finish for Service Areas: Rough bronze
3. Finish for Finished Rooms: Chrome or nickel plated.
4. Operation for Equipment Rooms: Wheel handle or operating key.
5. Operation for Service Areas: Operating key.
6. Operation for Finished Rooms: Operating key.
7. Include operating key with each operating-key hose bibb.
8. Include integral wall flange with each chrome- or nickel-plated hose bibb.

C. Deep-Seal Traps: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap seal primer valve connection.

1. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
2. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

D. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.

E. Fixed Air-Gap Fittings: Manufactured cast-iron or bronze drainage fitting with semiopen top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.

F. Stack Flashing Fittings: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.

G. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.

H. Vent Terminals: Commercially manufactured, shop- or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

2.13 SLEEVE PENETRATION SYSTEMS

A. Available Manufacturers:

2.14 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
2. Vent Pipe Flashing: 3-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.

B. Copper Sheet: ASTM B 152 (ASTM B 152M), of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).
2. Vent Pipe Flashing: 8 oz./sq. ft. (2.5 kg/sq. m or 0.27-mm thickness).

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness, unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.15 CLEANOUTS

A. Cleanouts

1. Application: Floor cleanout, Wall cleanout or for installation in exposed piping
2. Available Products:

   Zurn – 415 Type B
   Zurn – 400 Type I

   a. Smith, Jay R. Mfg. Co.
   b. Watts Industries, Inc., Drainage Products Div.
   c. Zurn Industries, Inc., Specification Drainage Operation.
   d. Charlotte Pipe & Foundry.

3. Body or Ferrule Material: Cast iron .
4. Clamping Device: Required.
5. Outlet Connection: Inside calk or spigot.
6. Closure: Brass plug with tapered threads.
7. Adjustable Housing Material: Cast iron threads.
8. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
9. Frame and Cover Shape: Round
10. Top Loading Classification: Heavy Duty.

2.16 FLOOR DRAINS

A. Floor Drains

1. Application: Floor drain.
2. Available Products:
   Zurn – Z-415 Type B
   Zurn – Z-415 Type N
   Zurn – Z-541-3

a. Josam Co.
b. Smith, Jay R. Mfg. Co.
c. Watts Industries, Inc., Drainage Products Div.
d. Zurn Industries, Inc., Specification Drainage Operation

3. Body Material: Gray iron.
4. Seepage Flange: Required.
5. Clamping Device: Required.
6. Outlet: Bottom .
7. Exposed Surfaces and Interior Lining: Not required.
8. Top or Strainer Material: Nickel bronze.
9. Top of Body and Strainer Finish: Nickel bronze.
10. Top Shape: Round.
11. Top Loading Classification: Heavy Duty .
12. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
13. Trap Material: Cast iron.
14. Trap Pattern: Standard P-trap.

2.17 CONDENSATE DRAINS

A. Condensate Drains

1. Application: Condensate drain.
2. Available Products:
   Zurn – Z-326-DB 3" OUTLET

   a. Josam Co.
   b. Smith, Jay R. Mfg. Co.
   c. Watts Industries, Inc., Drainage Products Div.
   d. Zurn Industries, Inc., Jonespec Div.

3. Drain Type: Indirect waste funnel.
4. Body Material: Gray iron.
5. Outlet: Bottom
6. Accessories: Bottom dome strainer

2.18 ROOF DRAINS

A. Roof Drains, Comply with ASME A112.21.2M

1. Application: Roof drain.
2. Available Products:
3. Products:

   a. Josam Co.; Model 21500 see plans for outlet sizes
   b. Smith, Jay R. Mfg. Co.;
   c. Thunderbird Products, Inc.;
   d. Watts Industries, Inc., Drainage Products Div.;
   e. Zurn Industries, Inc., Jonespec Div.;

4. Body Material: Cast iron.
5. Dimensions of Body: 15" dia.

6. Combination Flashing Ring and Gravel Stop: Required.
7. Outlet: Bottom.
8. Dome Material: Cast iron.
9. Sump Receiver: Required.

2.19 OVERFLOW DRAINS

A. Roof Drains, Comply with ASME A112.21.2M

1. Application: Roof drain.
2. Available Products:
3. Products:

   a. Josam Co.; Model 26010 see plans for outlet sizes
   b. Smith, Jay R. Mfg. Co.;
   c. Watts Industries, Inc., Drainage Products Div.;
   d. Zurn Industries, Inc., Jonespec Div.;

4. Body Material: Cast iron.
5. Dimensions of Body: 18" dia.
6. Combination Flashing Ring and Gravel Stop: Required.
7. Outlet: Bottom.
8. Dome Material: Cast iron.
9. Sump Receiver: Required.
10. Downspout Nozzle: Josam 25010; see plans for outlet sizes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.

D. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.

E. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

F. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

G. Install expansion joints on vertical risers, stacks, and conductors if indicated.

H. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate at base of each vertical soil and waste stack.

I. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.

J. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.

K. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.

L. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.

M. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.

N. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
    b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
    c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

O. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.

P. Fasten recessed-type plumbing specialties to reinforcement built into walls.

Q. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.

R. Install individual shutoff valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Division 15 Section "Valves" for general-duty ball, butterfly, check, gate, and globe valves.

S. Install air vents at piping high points. Include ball, gate, or globe valve in inlet .

T. Install traps on plumbing specialty drain outlets.

U. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect plumbing specialties to piping specified in other Division 15 Sections.

D. Ground equipment.

E. 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.

F. Connect plumbing specialties and devices that require power according to Division 16 Sections.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 7 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each backflow preventer, thermostatic water mixing valve, water tempering valve, and trap seal primer system.

1. Text: Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
2. Refer to Division 15 Section Mechanical Identification for nameplates and signs.

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 15430

SECTION 15441 - DOMESTIC WATER PUMPS

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 all-bronze and bronze-fitted centrifugal pumps for domestic cold- and hot-water circulation:
   1. Close-coupled, horizontally mounted, in-line centrifugal pumps.

1.3 SUBMITTALS

A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For domestic water pumps to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water pumps and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to 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, manufacturers specified.

2.2 CLOSE-COUPLED, HORIZONTALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers:

1. Armstrong Pumps Inc.
2. Bell & Gossett Domestic Pump; ITT Industries.
3. Marshall Engineered Products Co.
4. Paco Pumps, Inc.
5. Thrush Company, Inc.
6. Weinman Div.; Crane Pumps & Systems.

B. Description: Factory-assembled and -tested, overhung impeller, single-stage, close-coupled, horizontally mounted, in-line centrifugal pumps as defined in HI 1.1-1.2 and HI 1.3; and designed for installation with pump and motor shafts mounted horizontally.

1. Pump Construction: All bronze.

a. Casing: Radially split, cast iron, with threaded companion-flange connections for pumps with NPS 2 (DN 50) pipe connections and flanged connections for pumps with NPS 2-1/2 (DN 65) pipe connections.
b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, closed, and keyed to shaft.
c. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
d. Seal: Mechanical, with carbon rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.
e. Bearings: Oil-lubricated; bronze-journal or ball type.

2. Shaft Coupling: Rigid type if pump is provided with coupling.
3. Motor: Single speed, with grease-lubricated ball bearings. Comply with requirements in Division 15 Section "Motors."

C. Capacities and Characteristics:
1. See schedules on drawings.

2.3 CONTROLS

A. Thermostats: Electric; adjustable for control of hot-water circulation pump.

1. Manufacturers:

a. Honeywell International, Inc.
b. Square D.
c. White-Rodgers Div.; Emerson Electric Co.

2. Type: Water-immersion sensor, for installation in hot-water circulation piping.
3. Range: 65 to 200 deg F (18 to 93 deg C).
4. Operation of Pump: On or off.
5. Transformer: Provide if required.
6. Power Requirement: 120 V, ac.
7. Settings: Start pump at 105 deg F (41 deg C) and stop pump at 115 deg F (49 deg C) for domestic hot water. For kitchen system, start at 135 deg F and stop at 140 deg F.

2.4 BUILDING-AUTOMATION-SYSTEM INTERFACE

A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:

1. On-off status of each pump.
2. Alarm status.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Install close-coupled, horizontally mounted, in-line centrifugal pumps with motor and pump shafts horizontal.

E. Install continuous-thread hanger rods and elastomeric hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Division 15 Section "Mechanical Vibration and Seismic Controls." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 15 Section "Hangers and Supports."

3.3 CONTROL INSTALLATION

A. Install immersion-type thermostats in hot-water return piping.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 15 Section "Domestic Water Piping."

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
   a. Close-coupled, horizontally mounted, in-line centrifugal pumps.

2. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 15 Section "Valves" for general-duty valves for domestic water piping and Division 15 Section "Plumbing Specialties" for strainers.
3. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 15 Section "Meters and Gages" for pressure gages and gage connectors.

D. Ground equipment according to Division 16 Section "Grounding and Bonding."

E. Connect wiring according to Division 16 Section "Conductors and Cables."

F. Connect thermostats to pumps that they control.

G. Interlock pump with water heater burner and time delay relay.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set thermostats for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:

   a. Verify bearing lubrication.
   b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
   c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.

9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 15441

SECTION 15485 - ELECTRIC WATER HEATERS

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 electric water heaters:

1. Commercial, storage electric water heaters.
2. Compression tanks.
3. Water heater accessories.

1.3 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Product Certificates: For each type of commercial electric water heater, signed by product manufacturer.

D. Operation and Maintenance Data: For electric water heaters to include in emergency, operation, and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of electric water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of electric water heaters and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

C. 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.

D. ASME Compliance: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

1.5 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.6 WARRANTY

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

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period(s): From date of Substantial Completion:

a. Commercial Electric Water Heaters:

1) Storage Tank: Three years.
2) Controls and Other Components: One year.

b. Compression Tanks: One year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to 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, manufacturers specified.

2.2 COMMERCIAL ELECTRIC WATER HEATERS

A. Commercial, Storage Electric Water Heaters: Comply with UL 1453 requirements for storage-tank-type water heaters.

1. Available Manufacturers:

a. American Water Heater Company.
b. HESco Industries, Inc.

c. Precision Boilers.
d. PVI Industries, LLC.
e. Rheem Water Heater Div.; Rheem Manufacturing Company.
f. Ruud Water Heater Div.; Rheem Manufacturing Company.
g. Smith, A. O. Water Products Company.
h. State Industries, Inc.

2. Storage-Tank Construction: ASME-code, steel vertical arrangement.

a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.

1) NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.
2) NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.

b. Pressure Rating: 150 psig (1035 kPa).
c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings. Tank interior shall be coated with glass specifically developed for water heater use.

3. Factory-Installed Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.
b. Drain Valve: Brass construction with hose connection and complying with ASSE 1005.
c. Insulation: Foam type compling with ASHRAE/IESNA 90.1.
d. Jacket: Steel with baked enameled finish.
e. Handhole Cleanout: 4" x 6" size.
f. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.

1) Staging: Input not exceeding 12 kW per step.

g. Temperature Control: Adjustable, close differential, immersion type thermostat.
h. Contactors: Magnetic, heavy-duty type UL rated for 100,000 cycles.
i. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
j. Hinged control compartment door.
k. Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

2.3 COMPRESSION TANKS

A. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

1. Available Manufacturers:

   a. AMTROL Inc.
   b. Armstrong Pumps, Inc.
   c. Flexcon Industries.
   d. Honeywell Sparco.
   e. Myers, F. E.; Pentair Pump Group (The).
   f. Smith, A. O.; Aqua-Air Div.
   g. State Industries, Inc.
   h. Watts Regulator Co.
   i. Wessels Co.

2. Construction:

   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
   b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.

3. Capacity and Characteristics:

   a. Working-Pressure Rating: 150 psig (1035 kPa).
   b. Capacity Acceptable: 2 gal. (7.6 L) minimum.
   c. Air Precharge Pressure: 60 psig.

2.4 WATER HEATER ACCESSORIES

A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

B. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than water heater working-pressure rating.

C. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches (457 mm) above the floor.

D. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

C. Prepare test reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases.
1. Concrete base construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install thermometer on outlet piping of water heaters. Refer to Division 15 Section "Meters and Gages" for thermometers.

E. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

F. Fill water heaters with water.

G. Charge compression tanks with air.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

C. Ground equipment according to Division 16 Section "Grounding and Bonding."

D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial electric water heaters. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 15485

SECTION 16000

ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions, Division One of the Contract including General and Supplementary Conditions and General Requirements, apply to the work specified in Division 16.

B. Painting: Refer to Division 1-14 Sections.

C. Cutting and Patching: Refer to Division 1-14 Sections.

D. Concrete: Refer to Division 1-14 Sections.

1.2 DESCRIPTION OF WORK

A. The work includes furnishing all labor, materials, equipment and services required for the complete installation of the electrical systems indicated. The systems shall be installed complete and ready for use.

1.3 CONTRACT DOCUMENTS

A. Review the Contract Documents and coordinate all work with all other trades as necessary to provide equipment manufacturer's recommended clearances, to provide equipment operation such that it is not detrimental to other equipment, and to avoid conflicts and interference.

B. Coordinate fuse, disconnect, wire and breaker size requirements with other trades to suit particular equipment provided by other trades.

C. Locations indicated for switches, outlets, equipment, and other devices indicated are approximate and shall be field verified with the Owner's representative.

1.4 SUBSTITUTIONS

A. Where substitution of other than specified equipment is made and such change requires changes in the electrical power supply (wire, conduit, circuit breakers, starters, etc.), the contractor installing substituted equipment shall include in his bid the cost for the electrical changes required.

1.5 CODES

A. Installation shall comply with all laws applying to electrical installation. The work shall be in accordance with the latest edition of the following codes and all local governing codes and ordinances and with the regulations of the serving utility company, as a minimum:

1. NFPA 70 - National Electrical Code

2. NFPA 72 - National Fire Alarm Code

3. NFPA 101 - Life Safety Code

B. Where requirements of the contract documents are in excess of the above code requirements, the contract documents shall govern.

1.6 PERMITS

A. General: Provide all required permits.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver equipment, components, accessories and materials in factory packaged water-resistant type containers or protect from the weather by other means approved by the Designer.

B. Handle products carefully to avoid damage to component and to finish. Do not install damaged materials, replace and remove from project site.

C. Provide and maintain at all times a protective cover of not less than 0.004" thick polyethylene sheeting or a similar approved material for covering all items of equipment immediately after the equipment has been set in place or if in a place of storage at the construction site. This covering shall be maintained to prevent the accumulation of dirt or other foreign materials on the equipment and to prevent fouling of working parts during construction.

1.8 EXCAVATION AND BACKFILL

A. Normal excavation and backfill for installation of electrical work shall be provided under this Division. Heavy, hydraulic-operated equipment shall not be used for backfill.

B. If rock is encountered during normal excavation, notify the Designer immediately.

1.9 SUBMITTALS

A. Product Data: Product data includes manufacturer's standard catalog data, installation instructions and recommendations, drawings, certifications and other detailed information describing the material and product specified.

1. Indicate any deviations from the specified item.

B. Shop Drawings: Shop drawings include specific information not found in manufacturer's standard product data. Information shall include dimensions of products and equipment, charts and graphs and other descriptive information required to completely identify the item specified.

1. Indicate any deviations from the specified item.

C. Record Documents: Refer to Division 1.

1.10QUALITY ASSURANCE

A. Materials shall comply with standards of Underwriter's Laboratories, Inc., where standards have been established for the particular product and the various NEMA, ANSI, ASTM, IEEE, AEIC, ICEA or other publications referenced.

1.11PROTECTION OF ELECTRICAL EQUIPMENT

A. Protect electrical equipment from the weather, in particular, dripping or splashing water, at all times during shipment, storage and construction. Comply with manufacturer's recommendations with regard to storage and protection. Should any apparatus be subjected to possible injury by water, thoroughly dry and test in accordance with manufacturer's instructions and recommendations. The cost of testing shall be at the expense of the Contractor. Test equipment required shall be provided by the Contractor.

B. Inspect all electrical equipment and materials prior to installation. Damaged equipment and materials shall not be installed or placed in service until the Owner has been notified and a response received from the Owner regarding the disposition of the equipment or materials.

1.12WORKING CLEARANCES

A. Working clearances around equipment requiring electrical service shall comply with Code requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment shall be new and shall be listed by the Underwriter's Laboratories, Inc., for the use intended when a standard for such material and use exists.

B. All products and materials shall comply with all applicable standards and publications of NEMA, ANSI, ASTM, IEEE, AEIC, ICEA or other publications referenced.

C. All equipment of a particular kind such as wiring devices and panelboards, all lighting fixtures of the same category, shall be the product of the same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION – GENERAL

A. Install materials and equipment in accordance with manufacturer's instructions and recommendations. Care shall be used in the erection of equipment and material to avoid causing damage. Repair of damaged equipment shall be made at no additional expense to the Owner.

B. All enclosures and raceway installed on interior of exterior building wall shall be mounted on strut or "clamp-backs" spaced a minimum of ¼" off wall surface.

3.2 PLACING EQUIPMENT IN SERVICE

A. Equipment requiring electrical service shall not be energized or placed in service until all interested parties have been notified and are present or have waived their right to be present. Where equipment to be placed in service involves service or connection from another contractor or the Owner, the Contractor shall notify the Owner in writing when the equipment will be ready. The Owner shall be notified as far in advance as possible, of the date the various items of equipment will be complete.

3.3 INSPECTIONS

A. It shall be the responsibility of the Electrical Contractor to notify the code enforcing authorities and to schedule all required inspections with the State, County, & City officials (where applicable), and local authority having jurisdiction.

3.4 OPENINGS AND SLEEVES FOR ELECTRICAL WORK

A. Provide openings through walls, partitions, floors and roofs as required for the installation of electrical work.

B. Comply with Division 1-14 Sections regarding protection of openings in fire rated and smoke tight construction.

C. Provide sleeves for electrical work passing through walls, partitions, floors and roofs.

1. Where conduits pass through waterproofed floor or walls, design of sleeves shall be such that waterproofing can be flashed into and around the sleeves.

2. Sleeves in concrete and masonry walls, concrete floors and roofs shall be of standard weight steel pipe, finished with smooth edges. Sleeves for walls and partitions other than masonry, concrete and suspended ceilings shall be 22 gauge galvanized steel.

3. Floor sleeves shall extend 3 inches above the finished floor unless otherwise indicated. Space between the floor sleeve and passing conduit shall be sealed with approved materials.

3.5 SUPPORTS FOR CONDUIT AND EQUIPMENT

A. Support conduit from structural members and not from metal deck and slab assemblies.

B. Support lighting fixtures and other equipment from structural members.

3.6 FINAL INSPECTION AND TESTING

A. The work shall be thoroughly tested in the presence of the Owner's representative to demonstrate that the entire system is in proper working order and in accordance with the contract documents. Operate all motor driven equipment as nearly as possible under operating conditions for a sufficient length of time to demonstrate correct alignment, wiring capacity, speed and satisfactory operation. All main switches and circuit breakers shall be operated, but not necessarily at full load. During final inspection, furnish the test instruments and qualified personnel to perform complete testing.

B. Costs of tests, including expenses incident to retest occasioned by defects and failures of the equipment to meet the requirements specified shall be paid by the Electrical Contractor.

END OF SECTION 16000

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

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. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Common electrical installation requirements.

1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

1.6 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.

4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to 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, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.3 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM. Interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
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.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items. Unless noted otherwise on plans.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

C. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

D. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

E. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

F. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

G. Cut sleeves to length for mounting flush with both surfaces of walls.

H. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

I. 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.

J. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

K. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

L. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with Division 7 Section "Through-Penetration Firestop Systems."

M. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

N. Aboveground, Exterior-Wall Penetrations: Seal penetrations using 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.

O. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

3.5 FIELD QUALITY CONTROL

A. Inspect installed sleeve and sleeve-seal installations and associated firestopping for damage and faulty work.

END OF SECTION 16050

SECTION 16060

GROUNDING AND BONDING

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 methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

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

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
   1. Ground rods.
   2. Grounding for sensitive electronic equipment.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

   1. Instructions for periodic testing and inspection of grounding features at test wells and grounding connections for separately derived systems based on NFPA 70B.

      a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
      b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

   1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise on-site testing specified in Part 3.

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 UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V 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: Rectangular bars of annealed copper, 1/4 by 2 inches (6 by 50 mm) in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory 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, bolted 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.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad , 3/4 inch by10 feet (19 mm by 3 m) in diameter.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with non-hazardous electrolytic chemical salts.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger, unless otherwise indicated.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: 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: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

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. 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.
8. 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: Install a separate insulated equipment grounding conductor to each electric water heater. Bond conductor to heater units, piping, connected equipment, and components.

E. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

F. Boxes with concentric, eccentric or over-sized knockouts shall be provided with bonding bushings and jumpers. The jumpers shall be sized per NEC and lugged to the box.

3.3 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.

B. Ground Rods: Drive rods until tops are 2 inches (50 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.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. 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 so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

D. 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, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, 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.

E. 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.

F. 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.

G. Where one building is feeding another building and a grounding conductor is run with the ungrounded conductors, a metallic conduit can be provided between the buildings to establish improved grounding system.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

B. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. 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 not less 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.

3. Prepare dimensioned drawings locating each 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. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
2. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).

D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 16060

SECTION 16072

ELECTRICAL SUPPORTS AND SEISMIC RESTRAINTS

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. Hangers and supports for electrical equipment and systems.
2. Seismic restraints for electrical equipment and systems.
3. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. NCBC: North Carolina Building Code

C. IMC: Intermediate metal conduit.

D. RMC: Rigid metal conduit.

E. Seismic Restraint: A structural support element such as a metal framing member, a cable, an anchor bolt or stud, a fastening device, or an assembly of these items used to transmit seismic forces from an item of equipment or system to building structure and to limit movement of item during a seismic event.

1.4 SUBMITTALS

A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of electrical support and seismic-restraint component used.

1. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
2. Annotate to indicate application of each product submitted and compliance with requirements.

B. Shop Drawings: Indicate materials and dimensions and identify hardware, including attachment and anchorage devices, signed and sealed by a qualified professional engineer. Professional engineer qualification requirements are specified in Division 1 Section "Quality Requirements." Include the following:

1. Fabricated Supports: Representations of field-fabricated supports not detailed on Drawings.

2. Seismic Restraints: Detail anchorage and bracing not defined by details or charts on Drawings. Include the following:

   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Detail fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
   c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Qualification Data: For professional engineer.

F. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the NCBC unless requirements in this Section are more stringent.

B. Testing of Seismic Anchorage Devices: Comply with testing requirements in Part 3 and in Division 16 Section "Electrical Supports and Seismic Restraints."

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 PROJECT CONDITIONS

A. Site Class as Defined in the IBC: C.

B. See Architectural Drawing and Structural Drawing for applicable code related performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to 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, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.

B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly.

1. Available Manufacturers:

a. Cooper B-Line; a division of Cooper Industries.
b. ERICO International Corporation.
c. Allied Support Systems; Power-Strut Unit.
d. GS Metals Corp.
e. Michigan Hanger Co., Inc.; O-Strut Div.
f. National Pipe Hanger Corp.
g. Thomas & Betts Corporation.
h. Unistrut; Tyco International, Ltd.
i. Wesanco, Inc.

2. Finishes:

a. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-3.
b. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-3.
c. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-3.

3. Channel Dimensions: Selected for structural loading and applicable seismic forces.

C. 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. Available Manufacturers:

a. Allied Support Systems; Aickinstrut Unit.
b. Cooper B-Line; a division of Cooper Industries.
c. Fabco Plastics Wholesale Limited.
d. Seasafe, Inc.

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.
4. Rated Strength: Selected to suit structural loading and applicable seismic forces.

D. Raceway and Cable Supports: As described in NECA 1.

E. Conduit and Cable Support Devices: Hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

F. 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.

G. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

H. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

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. Available Manufacturers:

1) Hilti, Inc.
2) ITW Construction Products.
3) MKT Fastening, LLC.
4) Simpson Strong-Tie Co. Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, [**zinc-coated**] [**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. Available Manufacturers:

1) Cooper B-Line; a division of Cooper Industries.
2) Empire Tool and Manufacturing Co., Inc
3) Hilti, Inc.
4) ITW Construction Products.
5) MKT Fastening, LLC.
6) Powers Fasteners.

3. Concrete Inserts: Steel or malleable-iron slotted-support-system units similar to MSS Type 18; complying with MFMA-3 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, high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 SEISMIC-RESTRAINT COMPONENTS

A. Rated Strength, Features, and Application Requirements for Restraint Components: As defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Strength in tension, shear, and pullout force of components used shall be at least five times the maximum seismic forces to which they will be subjected.

B. Angle and Channel-Type Brace Assemblies: Steel angles or steel slotted-support-system components; with accessories for attachment to braced component at one end and to building structure at the other end.

C. Cable Restraints: ASTM A 603, zinc-coated, steel wire rope attached to steel or stainless-steel thimbles, brackets, swivels, and bolts designed for restraining cable service.

1. Available Manufacturers:

a. Amber/Booth Company, Inc.
b. Loos & Co., Inc.
c. Mason Industries, Inc.

2. Seismic Mountings, Anchors, and Attachments: Devices as specified in Part 2 "Support, Anchorage, and Attachment Components" Article, selected to resist seismic forces.
3. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod, of design recognized by an agency acceptable to authorities having jurisdiction.
4. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to type and size of anchor bolts and studs used.
5. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to type and size of attachment devices used.

2.4 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 5 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. 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.

B. 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 trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
2. Secure raceways and cables to these supports with suitable listed clamps.

C. 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.

3.2 SUPPORT AND SEISMIC-RESTRAINT INSTALLATION

A. Raceway Support Methods: EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

B. Install seismic-restraint components using methods approved by the evaluation service providing required submittals for component.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

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: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts. Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69. Spring-tension clamps.
7. To Light Steel: Sheet metal screws.
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 by means that meet seismic-restraint strength and anchorage requirements.

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 5 Section "Metal Fabrications" 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. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and seismic criteria at Project.

B. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so expansion anchors will be a minimum of 10 bolt diameters from edge of the base.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of the base.
2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
6. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 3 Section "Cast-in-Place Concrete."

3.5 INSTALLATION OF SEISMIC-RESTRAINT COMPONENTS

A. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Restraint Cables: Provide slack within maximums recommended by manufacturer.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.6 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Make flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross expansion and seismic-control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to electrical equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

END OF SECTION 16072

SECTION 16075

ELECTRICAL IDENTIFICATION

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. Identification for conductors and communication and control cable.
2. Underground-line warning tape.
3. Warning labels and signs.
4. Instruction signs.
5. Equipment identification labels.
6. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

2.2 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.

1. Not less than 6 inches (150 mm) wide by 4 mils (0.102 mm) thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend shall indicate type of underground line.

2.3 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. 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 36 INCHES (915 MM)."

2.4 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (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.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength: 50 lb (22.6 kg), minimum.
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

PART 3 - EXECUTION

3.1 APPLICATION

A. Power-Circuit Conductor Identification: For conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

B. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.

C. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source and circuit number.

D. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data 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 Operation and Maintenance Manual.

E. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. 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.

2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

G. Instruction Signs:

1. Operating Instructions: 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.

2. Emergency Operating Instructions: 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.

H. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Nameplates: Nameplates shall be engraved, laminated phenolic with color surface as indicated with white core. Plates up to 8 square inches shall not be less than 1/16" thick material; plates larger than 8 square inches shall not be less than 1/8" thick.

2. Letter Style: Condensed Gothic, ½", minimum height.

3. Attachment: Nameplates shall be attached with self-tapping stainless steel screws as follows:

   a. To 12 Square Inches: 2 screws.
   b. Above 12 Square Inches: 6 screws.
   c. Blue: 120/208V Equipment
   d. Bright Red: Fire Alarm Equipment
   e. Green surface with white core for "Emergency systems".
   f. Orange – Telephone
   g. Brown - Data

4. Equipment to Be Labeled:

   a. Panelboards, electrical cabinets, and enclosures.
   b. Access doors and panels for concealed electrical items.
   c. Electrical switchgear and switchboards.
   d. Emergency system boxes and enclosures.
   e. Disconnect switches.
   f. Enclosed circuit breakers.
   g. Motor starters.
   h. Push-button stations.
   i. Contactors.
   j. Remote-controlled switches, dimmer modules, and control devices.
   k. Voice and data cable terminal equipment.
   l. Television/audio components, racks, and controls.
   m. Fire-alarm control panel and annunciators.
   n. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
   o. Monitoring and control equipment.
   p. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208/120-V Circuits:

    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.
    d. Neutral – White.
    e. Ground - Green

3. 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.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.

J. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.

END OF SECTION 16075

600

SECTION 16120

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

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

B. Qualification Data: For testing agency.

C. Field Quality-Control Test Reports: From Contractor.

1.4 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.

B. Comply with NFPA 70.

C. All wire and cables shall be listed by an "approved' third party testing agency.

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 CONDUCTORS AND CABLES

A. Manufacturers:

1. Alcan Aluminum Corporation; Alcan Cable Div.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

C. Conductor Material: Copper complying with NEMA WC -5, solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.

D. Conductor Insulation Types: Type THW and THHN-THWN complying with NEMA WC 5.

2.3 CONNECTORS AND SPLICES

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspaces: Type THHN-THWN, single conductors in raceway.

E. Exposed Branch Circuits, including in Crawlspaces: 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 and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.

H. Fire Alarm Circuits: Power-limited, fire-protective, signaling circuit cable.

I. Class 1 Control Circuits: Type THHN-THWN, in raceway.

J. Class 2 Control Circuits: Type THHN-THWN, in raceway.

K. Power and lighting Circuits minimum conductor size shall be #12 AWG.

3.2 INSTALLATION

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. 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.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 16 Section "Basic Electrical Materials and Methods."

F. Seal around cables penetrating fire-rated elements according to Division 7 Section "Through-Penetration Firestop Systems."

G. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."

H. Where the conductor length from the panel to the first outlet on a 120 V circuit exceeds 50 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG.

3.3 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 and UL 486B.

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.

1. Joints in solid conductors shall be spliced using Ideal "wirenuts", 3 M Company "Scotchlock" or "T&B Piggy" connectors in junction boxes, outlet boxes and lighting fixtures.

2. "Sta-kon" or other permanent type crimp connectors shall not be used for branch circuit connections.

3. Joints in stranded conductors shall be spliced by approved mechanical connectors and gum rubber tape or friction tape. Solderless mechanical connectors for splices and taps, provided with U/L-approved insulating covers, may be used instead of mechanical connectors plus tape.

4. Conductors, in all cases, shall be continuous from outlet to outlet and no splicing shall be made except within outlet or junction boxes, troughs and gutters.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing conductors and cables and before electrical circuitry has been energized, test for electrical continuity and short circuits.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

B. 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.
4. A copy of tests shall be sent to the State Construction Office, the Engineer of Record, and the owner.

END OF SECTION 16120

SECTION 16130

RACEWAYS AND BOXES

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 raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:
1. Division 7 Section "Through-Penetration Firestop Systems" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
2. Division 16 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquidtight flexible metal conduit.

F. LFNC: Liquidtight flexible nonmetallic conduit.

G. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 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.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

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 METAL CONDUIT AND TUBING

A. Manufacturer[s]:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. Electri-Flex Co.
5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
6. LTV Steel Tubular Products Company.
7. Manhattan/CDT/Cole-Flex.
8. O-Z Gedney; Unit of General Signal.
9. Wheatland Tube Co.

B. Rigid Steel Conduit: ANSI C80.1.

C. Aluminum Rigid Conduit: ANSI C80.5.

D. IMC: ANSI C80.6.

E. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.

F. Plastic-Coated IMC and Fittings: NEMA RN 1.

G. EMT and Fittings: ANSI C80.3.

1. Fittings: Set-screw type.

H. FMC: Zinc-coated steel.

I. LFMC: Flexible steel conduit with PVC jacket.

J. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Manufacturer[s]:

1. American International.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corp.
4. Cantex Inc.
5. Certainteed Corp.; Pipe & Plastics Group.
6. Condux International.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; Division of Hubbell, Inc.
12. Spiralduct, Inc./AFC Cable Systems, Inc.
13. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

E. LFNC: UL 1660.

2.4 METAL WIREWAYS

A. Manufacturer[s]:

1. Hoffman.
2. Square D.
3. Approved Equal.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1 or 3R as indicated on plans.

C. Fittings and Accessories: Include 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.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Hinged type unless indicated differently on plans.

F. Finish: Manufacturer's standard enamel finish.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturer[s]:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Emerson/General Signal; Appleton Electric Company.

3. Erickson Electrical Equipment Co.
4. Hoffman.
5. Hubbell, Inc.; Killark Electric Manufacturing Co.
6. O-Z/Gedney; Unit of General Signal.
7. RACO; Division of Hubbell, Inc.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet-PLM Division.
10. Spring City Electrical Manufacturing Co.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

H. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.6 FACTORY FINISHES

A. Finish: For enclosure, or cabinet components, provide manufacturer's standard paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:

1. Exposed: Rigid steel or IMC.
2. Concealed: Rigid steel or IMC.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R or 4 as indicated on plans.

B. Indoors:

1. Exposed: EMT 8' & above, below 8' rigid steel.
2. Concealed: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
4. Damp or Wet Locations: Rigid steel conduit.
5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:

    a. Damp or Wet Locations: NEMA 250, Type 4, nonmetallic.

C. Minimum Raceway Size: 1/2-inch trade size (DN 21).

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

3.2 INSTALLATION

A. Keep raceways at least 6 inches (150 mm) away from parallel runs of hot-water pipes. Install horizontal raceway runs above water piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 16 Section "Electrical Supports and Seismic Restraints."

D. Install temporary closures to prevent foreign matter from entering raceways.

E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

H. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.
3. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
4. Change from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above the floor.

I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.

2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

J. Join raceways with fittings designed and approved for that purpose and make joints tight.

1. Use insulating bushings to protect conductors.

K. EMT terminations shall be made utilizing plated-steel hexagonal conversion connectors. No pot metal, set screw or intended type couplings shall be utilized.

L. Terminations:

1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

M. 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.

N. In addition to above requirements, install raceways in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

O. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-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 at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

P. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

Q. Flexible Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

R. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 UNDERGROUND RACEWAYS

A. Raceways run external to building foundation walls, with the exception of branch circuit raceways, shall be encased with a minimum of three (3) inches of concrete on all sides.

1. Encased raceways must have a minimum cover of eighteen (18) inches, except for raceways containing circuits with voltages above 600 volts, which must have a minimum cover of thirty (30) inches.

2. Encased raceways shall be of a type approved by the NEC as "suitable for concrete encasement."

B. Branch circuit raceways run underground external to building foundation walls shall be run in raceways installed in accordance with the NEC, and shall be of a type approved by the NEC as "suitable for direct burial." Minimum raceway size shall be 3/4 inch.

C. All underground raceways shall be identified by underground line marking tape located directly above the raceway at 6 to 8 inches below finished grade. Tape shall be permanent, bright-colored, continuous printed, plastic tape compounded for direct burial not less than 6 inches wide and 4 mils thick. Printed legend shall be indicative of general type of underground line below.

D. Raceways run underground internal to building foundation walls shall be of a type and installed by a method approved by the NEC.

E. Where underground raceways are required to turn up into cabinets, equipment, etc., and on to poles, the elbow required and the stub-up out of the slab or earth shall be of rigid steel.

F. The raceway system shall not be relied on for grounding continuity. See Section 16060 Grounding and Bonding for clarification.

G. Where passing through a "below grade" wall from a conditioned interior building space, raceways shall be sealed utilizing fittings similar and equal to OZ/GEDNEY type "FSK" thru-wall fitting with "FSKA" membrane clamp adapter if required.

3.4 ABOVE GROUND RACEWAYS

A. Conduit shall be sized in accordance with the latest edition of the NEC unless shown otherwise, with minimum conduit size being 1/2 inch. Flexible metal and watertight ("sealtight") conduit in size 1/2 inch and larger are acceptable for motor, appliance and fixture connections provided green wire is installed and NEC is followed.

B. Conduit, exposed and concealed (except "in-slab"), shall be neatly installed parallel to, or at right angles to beams, walls and floors of buildings.

C. EMT may be utilized as permitted by the NEC, with the following restrictions. EMT shall not be installed:

1. Where tubing, couplings, elbows and fittings would be in direct contact with the earth or underground (in/below slab-on-grade or in earth).

2. Any location outdoors where the tubing, etc., would be exposed to the elements.

3. Where exposed to severe corrosive influence and/or severe physical damage.

D. The raceway system shall not be relied upon for grounding continuity. See Section 16060 Grounding and Bonding for clarification.

E. The use of "LB's" shall be limited where possible. Where necessary to use "LB's" sized above 2 inches, mogul units shall be installed.

F. PVC schedule 40 shall not be used exposed or concealed in gypsum walls, but may be used in CMU walls. PVC schedule 40 may be used in elevated floor slabs and in foundation slabs. Minimum concrete cover shall be 3/4 inch at finished or formed surface and shall be 3 inches at concrete surface cast against earth or for slabs placed on-grade. Greater amounts of concrete cover shall be used in areas subject to damage. The placement of conduit in floor slabs must be thoroughly coordinated with the structural design. Potential

conflicts with steel reinforcing bars and reductions in net concrete sections are among the issues that must be considered by the structural engineer.

3.5 TERMINATIONS

A. IMC and GRC shall terminate with either a double locknut / bushing set, or in a threaded hub.

B. Where concentric, eccentric or over-sized knockouts are encountered, a grounding-type insulated bushing shall be provided.

C. EMT terminations shall be made utilizing steel-plated hexagonal compression connectors. No pot metal, set screw or Indented type fittings shall be utilized.

D. EMT terminations shall be "concrete tight" where buried in masonry or concrete. EMT fittings, where installed in damp locations, shall be of the "raintight" type.

3.6 CONDUIT COUPLINGS

A. Where conduits of any type pass over a building expansion joint, a standard "expansion joint fitting," compatible with the type raceway being used, shall be provided.

B. Conduit couplings for IMC, GRC and PVC shall be in accordance with the NEC.

C. EMT couplings shall be of the plated-steel hexagonal compression type. No pot metal, set screw or Indented type couplings shall be utilized.

D. EMT couplings shall be "concrete tight" where buried in masonry or concrete. EMT fittings, where installed in damp locations, shall be of the "raintight" type.

3.7 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.8 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 16130

SECTION 16140

WIRING DEVICES

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. Single and duplex receptacles, ground-fault circuit interrupters.
2. Single- and double-pole snap switches and dimmer switches.
3. Device wall plates.
4. Pin and sleeve connectors and receptacles.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. PVC: Polyvinyl chloride.

D. RFI: Radio-frequency interference.

E. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

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

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.

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.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

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:

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

1. Wiring Devices:

a. Bryant Electric, Inc./Hubbell Subsidiary.
b. Eagle Electric Manufacturing Co., Inc.
c. Hubbell Incorporated; Wiring Device-Kellems.
d. Leviton Mfg. Company Inc.
e. Pass & Seymour/Legrand; Wiring Devices Div.

2.2 RECEPTACLES

A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498 and shall be "approved " third party listed.

B. Straight-Blade and Locking Receptacles: Heavy Duty grade or industrial specification grade.

C. GFCI Receptacles: Straight blade, feed through type, Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.

D. Self Grounding or Automatic type grounding receptacles are not acceptable in lien of receptacles with separate grounding screw lugs and a direct, green insulated conductor connection to the equipment grounding system.

E. Receptacle shall have side wired terminals with brass screws and hex head grounding screw.

2.3 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.

2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.4 SWITCHES

A. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.

B. Snap Switches: Heavy Duty grade, quiet type.

C. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.

1. Control: Continuously adjustable slider, with single-pole or three-way switching to suit connections.
2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable rotary knob, toggle switch, or slider; single pole with soft tap or other quiet switch; EMI/RFI filter to eliminate interference; and 5-inch (130-mm) wire connecting leads.

D. Wall switch shall have side wired terminals with brass screws and hex head grounding screws.

2.5 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Wet Locations: Thermoplastic with spring-loaded lift cover, and shall be "approved" and third party listed as "raintight while in use".
5. Quantity of 2% spare cover plates of each type shall be provided to the owner.

2.6 FINISHES

A. Color:

1. Gray unless otherwise indicated or required by NFPA 70.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies level, plumb, and square with building lines.

B. Install wall dimmers to achieve indicated rating after derating for ganging according to manufacturer's written instructions.

C. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.

D. 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, multigang wall plates.

E. Remove wall plates and protect devices and assemblies during painting.

3.2 IDENTIFICATION

A. Comply with Division 16 Section "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 CONNECTIONS

A. Ground equipment according to Division 16 Section "Grounding and Bonding."

B. Connect wiring according to Division 16 Section "Conductors and Cables."

C. 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. Perform the following field tests and inspections and prepare test reports:

1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 16140

16262

GREEN TECHNOLOGY MONITORING 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:
1. Solar energy electrical power generation monitoring equipment
2. Solar Thermal energy monitoring equipment
3. Rainwater Catchment and Reuse equipment
4. Daylighting energy savings monitoring equipment
5. Advanced weather stations
6. Geothermal energy monitoring equipment
7. Local display equipment (large format monitor or interactive kiosk)

B. Related Sections include the following:
1. Division 5 Section "Metal Fabrications" for metal framing systems for equipment mounting.
2. Division 6 Section "Rough Carpentry" for wood framing systems for equipment mounting.
3. Division 16 Section "Grounding and Bonding for Electrical Systems" for grounding of equipment.
4. Division 16 Section "Raceway and Boxes for Electrical Systems" for building voltage equipment.
5. Division 16 Section "Hangers and Supports for Electrical Systems" for building voltage equipment.
6. Division 16 Section "Circuit Protection Devices" for building voltage equipment.
7. Division 16 Section "Cables" for building voltage equipment.
8. Division 16 Section "Switchboards and Panelboards" for building voltage equipment.
9. Division 16 Section "Photovoltaic Collectors" for photovoltaic collectors
10. Division 16 Section "Data Communications" for communications equipment.
11. Division 16 Section "Solar Energy Electrical Power Generation Equipment".

1.3 REFERENCES

1. NEMA National Electrical Manufacturers Association
   a. NEMA 250-2003: National Electrical Manufacturers Association Standards Publication 250-2003 - Enclosures for Electrical Equipment (1000 Volts Maximum)

1.4 SYSTEM DESCRIPTION

A. Provide green technology monitoring equipment as part of an integrated hardware and software based monitoring system with the following capabilities:
1. Able to measure the following:
   a. Site-specific solar energy resource (input)
   b. Site-specific rainfall resource or precipitation (input)
   c. Fluid temperatures (input)
   d. Fluid flow rates (input)
   e. DC energy generated (output)
   f. AC energy generated (output)
   g. BTU energy generated (output)
   h. Water delivered (output)
   i. Total PV system efficiency
   j. Total Solar thermal system efficiency

k. Total Daylighting energy savings
l. Geothermal coefficient of performance
m. Back of PV module temperature (input)
n. Back of Solar thermal panel temperature (input)
o. Barometric pressure (input)
p. Relative humidity (input)
q. Wind direction (input)

2. Able to continue to collect, record and store data during temporary power or communications interruptions. Once communication is restored, system shall be capable to upload stored data to ensure a complete performance record with no missing data records.
   a. Duration: provide this capacity for 5 days minimum
   b. Duration: provide this capacity for 5 weeks minimum
3. Able to display and provide keypad access to status and diagnostic information locally without requiring an Internet connection or local computer to access the system.
4. Able to provide PV monitoring accepted by the California Energy Commission to qualify for performance based incentives and Renewable Energy Credits.
5. Able to display informational data as graphical displays through the following world wide web based interfaces:
   a. Dials to provide quick information available at a glance capable of showing a single value within a range, or to compare multiple values.
   b. Data Tables to provide dynamic table display of different values depending on the type of data selected for the graphical display.
   c. Historical trend graphs to explore the data in detail over a 2-day, 7-day, 31-day, or user defined define time range. The type of data displayed shall be selectable via tabs on the web page.
6. Able to download data over a user defined time period in a standard data format (comma separated variable or .csv) which can be imported into spreadsheets and other computer programs.
7. Able to monitor system performance by optionally breaking out the renewable energy source to DC efficiency and the DC to AC efficiency. AC measurements shall optionally include 2- and 3-phase voltages, currents and total harmonic distortion.
8. Able to provide visual display for ambient temperature, wind speed and wind direction through a Dynamic Data Table displaying the current weather readings and average or min/max statistics.
9. Able to provide visual display for ambient temperature, wind speed, wind direction, precipitation, barometric pressure, and relative humidity through a Dynamic Data Table displaying the current weather readings and average or min/max statistics. Also able to provide analysis with wind rose plots that combine historic wind speed and direction data on a single plot.
10. Able to track PV inverter status and fault codes and log internal inverter measurements through an inverter information page graphing internal inverter measurements of power, energy, voltage, current, and temperature depending on inverter monitoring capabilities.
11. Able to monitor the alarm status of the system and generate email or text message alerts (for cell phones that support receiving emails as text messages) and provide diagnostic datalogger voltage, temperature, and communications history information.
12. Able to monitor the net energy (to or from the grid) at the point of utility interconnection to compare the energy generated with the energy consumed (the load). Through display of an energy flow animation comparing renewable energy generation to the energy obtained from the utility.
    a. Such capability shall include the ability to monitor net energy for each portion of the Project indicated to be sub-metered.

1.5 SUBMITTALS

A. Product Data: Submit monitoring equipment product data to include options selected, monitoring system layout including wiring diagrams, power requirements, communications requirements, and installation instructions.

B. Qualification Data: Submit qualification data for Installer, Supplier and Manufacturer. Include manufacturer's certification where supplier or installer is required to be a manufacturer's authorized representative.

C. Operation and Maintenance Data: Submit operation and maintenance data for monitoring equipment to include in operation and maintenance manuals.

D. Sample Warranty: Submit unexecuted copy of actual warranty for monitoring equipment as specified in this Section.

E. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner with terms, conditions, and obligations starting on date initial maintenance service is concluded.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Installer shall be the monitoring equipment manufacturer or manufacturer's authorized representative who is trained and approved by manufacturer to install products required for this Project. Installer shall be experienced with installing work on or more projects similar in quantity and quality to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance, and who has sufficient capacity to install required products in a timely manner. Installer shall have a continuous record of successful performance for no less than two years. Installers without such experience shall operate under the supervision of the manufacturer.

B. Manufacturer Qualifications: Manufacturer's shall be experienced with manufacturing products for projects similar in quantity and quality 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 in a timely manner. Manufacturer shall have a continuous record of successful performance for no less than five years.

C. Supplier Qualifications: Supplier shall be the monitoring equipment manufacturer or manufacturer's authorized representative who is trained and approved by manufacturer to furnish products required for this Project. Supplier shall be experienced with furnishing products for two or more projects similar in quantity and quality to those indicated for this Project and with a record of successful in-service performance, and who has sufficient capacity to furnish required products in a timely manner. Supplier shall have a continuous record of successful performance for no less than two years. Suppliers without such experience shall operate under the supervision of the manufacturer.

D. Factory-Authorized Service Representative Qualifications: An authorized representative of monitoring equipment manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

E. Source Limitations: Obtain components of monitoring equipment specified in this Section through one source from a single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging.

B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

1.8 PROJECT CONDITIONS

A. Power Supply: Provide 120 Vac, 24 Watt, single phase properly grounded and circuit overload protected power supply for system unit.

B. Power Supply: Provide custom designed photovoltaic generated power supply.

C. Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, and other project conditions.

D. Coordinate installation of monitoring equipment with mounting substrate, electrical distribution and grounding, and electrical generation equipment.

E. Coordinate sequence of monitoring equipment installation with other work to avoid delaying the Work.

1.9 WARRANTY

A. Standard Manufacturer's Warranty: Provide manufacturer's standard form in which manufacturer agrees to furnish replacement parts for monitoring equipment which is defective in materials or factory workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

1.10 DATA MANAGEMENT AND SUPPORT SERVICES

A. Initial Maintenance Service: Beginning at Substantial Completion, provide one year's maintenance service by skilled employees of the installer. Include the following:
1. Customer support and troubleshooting services during normal business hours.
2. Secure management of system performance data including data collection, archiving and processing of data from use in graphical display accessible via a dedicated web site provided by the manufacturer. System information shall be available through a standard World Wide Web interface (browser) on any computer connected to the Internet.
3. Continued data management and support services available for a yearly fee.

B. Software upgrades: Software upgrades are included in data management and support services yearly fee.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Refer to specification for monitoring system for restrictions on manufacturers.

2.2 MONITORING SYSTEM

A. Monitoring System: Provide green technology monitoring equipment as part of an integrated monitoring system with the following components:
1. Data Acquisition System unit(s) (with all systems)
2. PV power system for Data Acquisition System unit(s)
3. Pyranometer(s) (one with solar electric and one with solar thermal systems)
4. Thermistor(s) (one with solar electric, four with solar thermal)
5. Fluid Flow Meter(s) (two with solar thermal systems, one with rainwater catchment and reuse, one with geothermal)
6. AC Meter(s) (with PV system)
7. DC Measurement(s) (one with PV systems)
8. BTU Meter(s) (one with solar thermal and one with geothermal systems)
9. Advanced weather station
10. Inverter interface units

B. Products: Subject to compliance with requirements.
1. Basis of Design: VER·TECH™ Monitoring Solution as manufactured by Draker Laboratories, Inc., 22 North Street, Burlington VT 05401, Tel: 802-865-3866, Fax: 802-861-2104, Web: www.drakerlabs.com, Email: info@drakerlabs.com or equivalent.

C. Wiring: Provide monitoring system with all components pre-wired with integrated sensor mounting and factory fabricated to lengths required by Project conditions.

2.3 SYSTEM UNIT

A. Provide integrated data acquisition enclosure with the following components:

1. Measurement and Control Module: CR200 or CR1000 as manufactured by Campbell Scientific or equivalent and pre-programmed by monitoring equipment manufacturer.
2. Enclosure: waterproof; rated 4X per NEMA 250-2003
3. Mounting Hardware: able to mount to Unistrut with spring nuts or equivalent
4. Internal backup battery: must have capacity of 7Ah or greater
5. Internal memory: 128 Kbytes or greater Flash memory (CR200-based units); 2 Mbytes or greater Flash memory (CR1000-based units)
6. Status Display: giving green technology and monitoring system status in easy-to-understand format (CR1000-based units)
7. Ethernet connection
8. Wireless data link

2.4 PYRANOMETERS

A. Provide silicon pyranometer to measure plane-of-array solar irradiance. Typical error ± 5%, stability less than ± 2% over one year period.

2.5 THERMISTORS

A. Provide thermistor to measure back-of-module temperature. Thermistor accuracy to be better than 2° C (CR200-based unit), 1° C (CR1000-based unit).

2.6 FLOW METER

A. Provide flow meter with contact closure or digital output.

2.7 ANEMOMETERS

A. Provide two anemometers capable of calculating wind speed at turbine hub and wind turbulence. Anemometer accuracy < 0.1 m/s (5 m/s to 25 m/s) with starting threshold ≤ 1.75 m/s.

2.8 WIND VANES

A. Provide wind vane capable of measuring wind direction. Range 360° mechanical, linearity ≤ 1%, dead band ≤ 8°.

2.9 AC METERS

A. Provide revenue grade multifunction electronic kWh AC power and energy meter which is accurate to ± 2% including current transformers.

2.10 DC MEASUREMENTS

A. Provide isolated DC voltage and current sensors mounted in an enclosure with an integrated monitoring system cable.

B. Provide multiple string or sub-array DC monitoring with an isolated DC voltage sensor and DC current sensors in a combiner box with an integrated cable. Combiner box shall be capable function as and replace normal combiner box.

2.11 BTU MEASUREMENTS

A. BTU measurement accuracy must meet industry standards

2.12 ADVANCED WEATHER STATION

A. Provide whether station capable of measuring ambient temperature, wind speed, wind direction, precipitation, barometric pressure, and relative humidity with the following components:

1. Ambient temperature thermistor.
2. Anemometer
3. Wind Vane
4. Precipitation Sensor
5. Barometric Pressure Sensor
6. Relative Humidity Sensor
7. Integrated data and power cable.

2.13 INVERTER INTERFACE UNITS

A. To the extent project specific inverter has such capabilities, provide inverter interface unit capable of:
1. Monitoring inverter status and fault codes,
2. Logging internal inverter measurements.

2.14 SOURCE QUALITY CONTROL

A. Source Quality Control Report: At time of delivery, include Manufacturer's factory test report for monitoring equipment to be supplied for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structure and other conditions under which monitoring equipment is to be installed for compliance with requirements.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install monitoring equipment in compliance with Manufacturer's instructions and local codes.

B. Secure system unit to substrate at accessible location.

C. Properly ground system unit.

D. Connect system unit to power supply.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field (Commissioning) Report: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Prepare written information documenting factory-authorized service representative's tests, observations and inspections. Include the following:
1. Name, contract information and signature of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times inspection is to be performed.

3.4 DEMONSTRATION

1. Refer to Division 1 Section 01820 "Demonstration and Training."

END OF SECTION

SECTION 16289

TRANSIENT VOLTAGE SUPPRESSION

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 TVSSs for low-voltage power, control, and communication equipment.

1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. SVR: Suppressed voltage rating.

C. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.

B. Product Certificates: For transient voltage suppression devices, signed by product manufacturer certifying compliance with the following standards:

1. UL 1283.
2. UL 1449.

C. Field quality-control test reports, including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Failed test results and corrective action taken to achieve requirements.

D. Operation and Maintenance Data: For transient voltage suppression devices to include in emergency, operation, and maintenance manuals.

E. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.

B. Product Options: Drawings indicate size, dimensional requirements, and electrical performance of suppressors and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

C. 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.

D. Comply with IEEE C62.41, "IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits," and test devices according to IEEE C62.45, "IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits."

E. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices."

F. Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449, "Transient Voltage Surge Suppressors."

1.6 PROJECT CONDITIONS

A. 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.

B. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
3. Humidity: 0 to 85 percent, noncondensing.
4. Altitude: Less than 20,000 feet (6090 m) above sea level.

1.7 COORDINATION

A. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within five years from date of final acceptance.

B. Special Warranty for Cord-Connected, Plug-in Surge Suppressors: Manufacturer's standard form in which manufacturer agrees to repair or replace electronic equipment connected to circuits protected by surge suppressors.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Replaceable Protection Modules: One of each size and type installed.

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:

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

1. Advanced Protection Technologies, Inc.
2. Atlantic Scientific.
3. Current Technology, Inc.
4. Cutler-Hammer, Inc.; Eaton Corporation.
5. Entrelec International.
6. General Electric Company.
7. Innovative Technology, Inc.
8. Intermatic, Inc.
9. LEA International.
10. Leviton Mfg. Company Inc.
11. Liebert Corporation; a division of Emerson.
12. Northern Technologies, Inc.
13. Siemens Energy & Automation, Inc.
14. Square D; Schneider Electric.
15. Surge Suppression Incorporated.
16. Sutton Designs Inc.
17. Transtector Systems, Inc.
18. Tycor; Cutler-Hammer, Inc.
19. United Power Corporation.
20. Zero Surge Inc.

2.2 SERVICE ENTRANCE SUPPRESSORS

A. Surge Protection Device Description: Non-modular, sine-wave-tracking type with the following features and accessories:

1. LED indicator lights for power and protection status.
2. Audible alarm, with silencing switch, to indicate when protection has failed.
3. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.

B. Surge Protection Device Description: Modular design with field-replaceable modules, sine-wave-tracking type with the following features and accessories:

1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Integral disconnect switch.

4. Redundant suppression circuits.
5. Redundant replaceable modules.
6. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
7. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
8. LED indicator lights for power and protection status.
9. Audible alarm, with silencing switch, to indicate when protection has failed.
10. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status. Coordinate with building power monitoring and control system.
11. Surge-event operations counter.

C. Peak Single-Impulse Surge Current Rating: 160 kA per phase.

D. Connection Means: Permanently wired.

E. Protection modes and UL 1449 SVR for grounded wye with voltage 208/120 V, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 400 V for 208/120.
2. Line to Ground: 400 V for 208/120.
3. Neutral to Ground: 400 V for 208/120.

2.3 PANELBOARD SUPPRESSORS

A. Surge Protection Device Description: Modular design with field-replaceable modules, sign-wave-tracking type with the following features and accessories:

1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Integral disconnect switch.
4. Redundant suppression circuits.
5. Redundant replaceable modules.
6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
7. LED indicator lights for power and protection status.
8. Audible alarm, with silencing switch, to indicate when protection has failed.
9. One set of dry contacts rated at 5 A and 250-V, ac, for remote monitoring of protection status. Coordinate with building power monitoring and control system.
10. Surge-event operations counter.

B. Peak Single-Impulse Surge Current Rating: 160 kA per phase.

C. Protection modes and UL 1449 SVR for grounded wye circuits with voltages of d- & 208Y/120 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 400 V for 208Y/120.
2. Line to Ground: 400 V for 208Y/120.
3. Neutral to Ground: 400 V for 208Y/120.

2.4 ENCLOSURES

A. NEMA 250, with type matching the enclosure of panel or device being protected.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTION DEVICES

A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.

B. Install devices for panelboard and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

1. Provide multipole, 30 A circuit breaker as a dedicated disconnect for suppressor, unless otherwise indicated.

3.2 PLACING SYSTEM INTO SERVICE

A. Do not energize or connect service entrance equipment or panelboards to their sources until surge protection devices are installed and connected.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust equipment installation, including connections. Report results in writing.

1. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. Testing: Perform the following field tests and inspections and prepare test reports:

1. After installing surge protection devices, but before electrical circuitry has been energized, test for compliance with requirements.
2. Complete startup checks according to manufacturer's written instructions.
3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.

C. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transient voltage suppression devices. Refer to Division 1 Section "Closeout Procedures and Demonstration and Training."

END OF SECTION 16289

SECTION 16300

ELECTRICAL SERVICE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The requirements of Section 16000 govern the work specified in this Section.

1.2 DESCRIPTION OF WORK

A. The electrical contractor shall provide the following:

1. Meterbase. (Contact Electrical Utility Co. for type and size)
2. Concrete pad for pad mounted transformer.
3. Secondary cable and conduit from transformer.

1.3 SUBMITTALS

A. Documentation: Submit documentation required by Division 1.

1.4 QUALITY ASSURANCE

A. Coordinate work with the Electrical Utility Co..

B. Comply with the requirements of Electrical Utility Co..

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wire and Cable: Refer to Section 16100.

B. Raceway: Refer to Section 16110.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide all documentation required by Electrical Utility Co..

END OF SECTION 16300

SECTION 16400

ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to Section 16000, Electrical General Requirements

1.2 DESCRIPTION OF WORK

A. Specific work to be done under Division 16 is hereinafter listed or described. All other work necessary for the operation of Division 15 equipment shall be performed under Division 15.

B. All individual motor starters for mechanical equipment (fans, pumps, etc.) shall be furnished and installed under Division 15 unless indicated as part of a motor control center.

C. Under Division 16, power wiring shall be provided up to a termination point consisting of a junction box, trough, starter, or disconnect switch. Under Division 16, line side terminations shall be provided. Wiring from the termination point to the mechanical equipment, including final connections, shall be provided under Division 15.

D. Duct smoke detectors shall be provided and wired by Division 16, installed by Division 15. Fire alarm AHU shut down circuits shall be wired from the fire alarm control panel to a termination point, adjacent to the fire alarm control panel, under Division 16. AHU control wiring from the termination point to the equipment will be under Division 15.

E. All relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, pneumatic-electric, and electric-pneumatic switches, aquastats, freezestats, line and low voltage thermostats, thermals, remote selector switches, remote push-button stations, emergency break-glass stations, interlocking, disconnect switches beyond termination point, and other appurtenances associated with equipment under Division 15 shall be furnished, installed, and wired under Division 15.

F. All wiring required for controls and instrumentation not indicated on the drawings shall be furnished and installed by Division 15.

G. Roof exhaust fans with built in disconnects provided under Division 15 shall be wired under Division 16 to the line side of the disconnect switch. A disconnect switch shall be provided under Division 16 if the fan is not provided with a built-in disconnect switch. In this case wiring from the switch to the fan shall be under Division 15.

H. Horse power for all motors shall be indicated on the Division 15 and Division 16 drawings.

I. Where electrical wiring is required by trades other than covered by Division 16, specifications for that section shall refer to the same wiring materials and methods as specified under Division 16. No exceptions.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 INSTALLATION

A. All motor connections shall be made so as to restrict vibration to branch circuit raceway (12" length minimum).

B. Fuses shall be provided in the disconnecting means where nameplates rating of equipment to be connected is based on fuses for protection.

END OF SECTION 16400

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SECTION 16410

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers.
4. Enclosures.

1.3 DEFINITIONS

A. GD: General duty.

B. GFCI: Ground-fault circuit interrupter.

C. HD: Heavy duty.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.4 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, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current rating.
4. UL listing for series rating of installed devices.
5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. 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 1 Section "Closeout Procedures and Operation and Maintenance Data" include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 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.

B. Comply with NFPA 70.

C. 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.

D. Safety switches shall be third-party listed.

1.6 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).

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spares: For the following:
   a. Fuses for Fusible Switches: 10% each type minimum of 3.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to 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, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.

B. Fusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. 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; and labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Moeller Electric Corporation.
4. Siemens Energy & Automation, Inc.
5. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, 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 250 A and larger.

C. Molded-Case Circuit-Breaker Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
5. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
6. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
7. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

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.

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

3.2 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 16 Section "Electrical Identification."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.
4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.

C. Perform the following field tests and inspections and prepare test reports:

1. Test mounting and anchorage devices according to requirements in Division 16 Section "Electrical Supports and Seismic Restraints."
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Infrared Scanning:

   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Open or remove doors or panels so connections are accessible to portable scanner.
   b. Follow-Up Infrared Scanning: Perform an additional follow-up infrared scan of each unit 11 months after date of Substantial Completion.
   c. Instruments, Equipment and Reports:

      1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
      2) Prepare a certified report that identifies enclosed switches and circuit breakers included and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.6 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 16410

SECTION 16420

ENCLOSED CONTROLLERS

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 ac, enclosed controllers rated 600 V and less, of the following types:

1. Across-the-line, manual and magnetic controllers.
2. Reduced-voltage controllers.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each enclosed controller.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.
b. Nameplate legends.
c. Short-circuit current rating of integrated unit.
d. UL listing for series rating of overcurrent protective devices in combination controllers.
e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around enclosed controllers where pipe and ducts are prohibited. Show enclosed controller layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For manufacturer and testing agency.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures and Operation and Maintenance Data" include the following:

1. Routine maintenance requirements for enclosed controllers and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

G. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

H. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.

D. 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.

E. Comply with NFPA 70.

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.6 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

C. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.

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:

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

1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
2. Danfoss Inc.; Danfoss Electronic Drives Div.
3. Eaton Corporation; Cutler-Hammer Products.
4. General Electrical Company; GE Industrial Systems.
5. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
6. Siemens/Furnas Controls.
7. Square D.

2.2 ACROSS-THE-LINE ENCLOSED CONTROLLERS

A. Manual Controller: NEMA ICS 2, general purpose, Class A, with toggle action and overload element.

B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.

1. Control Circuit: 120 V; obtained from integral control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
2. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 30 tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

3. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class 30 tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

C. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch.

1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.
2. Nonfusible Disconnecting Means: NEMA KS 1, heavy-duty, nonfusible switch.
3. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

2.3 ENCLOSURES

A. Description: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
3. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2.4 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

2.5 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosed controllers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. Install freestanding equipment on concrete bases.

B. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 16 Section "Fuses."

3.4 IDENTIFICATION

A. Identify enclosed controller, components, and control wiring according to Division 16 Section "Electrical Identification."

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers according to Division 16 Section "Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

A. Conduit installation requirements are specified in other Division 16 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 16 Section "Grounding and Bonding."

3.7 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect controllers, wiring, components, connections, and equipment installation. **Test** and adjust controllers, components, and equipment.
2. Report results in writing.

C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

D. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS, Motor Control - Motor Starters. 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.

3.8 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 16420

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SECTION 16442

PANELBOARDS

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. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage 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. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Bus configuration, current, and voltage ratings.
c. Short-circuit current rating of panelboards and overcurrent protective devices.
d. UL listing for series rating of installed devices.
e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring.

C. For installation in panelboards. Submit final versions after load balancing.

D. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section " Closeout Procedures and 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.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

C. 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.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
2. 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).

1.7 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, and encumbrances to workspace clearance requirements.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

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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:

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

1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:

a. Eaton Corporation; Cutler-Hammer Products.
b. General Electric Co.; Electrical Distribution & Protection Div.
c. Siemens Energy & Automation, Inc.
d. Square D.

2.2 MANUFACTURED UNITS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 16 Section "Electrical Supports and Seismic Restraints."

B. Enclosures: Flush or Surface mounted cabinets. NEMA PB 1, Type 1.

1. Rated for environmental conditions at installed location.

a. Outdoor Locations: NEMA 250, Type 3R.
b. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
6. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
7. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
8. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door. Provide typed directory.

C. Phase and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

D. Conductor Connectors: Suitable for use with conductor material.

1. Main and Neutral Lugs: Compression type.
2. Ground Lugs and Bus Configured Terminators: Compression type.

E. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

F. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. UL label indicating short circuit rating.

B. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 DISTRIBUTION PANELBOARDS

A. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.

B. Main Overcurrent Protective Devices: Circuit breaker.

C. Branch Overcurrent Protective Devices:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.6 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: 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 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. GFCI Circuit Breakers: Single- and two-pole configurations with 5mA trip sensitivity.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
5. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.

C. All breakers shall be bolt-on type.

D. Feed-through panels are not permitted.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.

C. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

D. Install overcurrent protective devices and controllers.

1. Set field-adjustable switches and circuit-breaker trip ranges.

E. Install filler plates in unused spaces.

F. Stub four 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.

G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Ground equipment according to Division 16 Section "Grounding and Bonding."

B. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. 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.

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.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scanning of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 16442

SECTION 16491

FUSES

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. Cartridge fuses rated 600 V and less for use in switches.

1.3 SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
2. Let-through current curves for fuses with current-limiting characteristics.
3. Time-current curves, coordination charts and tables, and related data.

B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

C. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 1 Section "Closeout Procedures and Operation and Maintenance Data" include the following:

a. Let-through current curves for fuses with current-limiting characteristics.
b. Time-current curves, coordination charts and tables, and related data.
c. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

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 NEMA FU 1.

D. Comply with NFPA 70. Fusible switches with short-circuit withstand rating of 100K amp or 200K amp require class-R or class-J rejection fuse block feature.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Quantity equal to 10% percent of each fuse type and size, but no fewer than 3 of each type and size.

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:

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

1. Cooper Bussman, Inc.
2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
3. Ferraz Shawmut, Inc.
4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. The following criteria shall be followed for fuse selection:

CIRCUIT TYPE	FUSE TYPE
Service Entrance & Feeder Circuits over 600A	Class L, U/L listed, current limiting with 200K Amp interrupting rating.
Service Entrance & Feeder Circuits 600A and less	Class RK1 or J, U/L listed, current limiting with 200K Amp interrupting rating
Motor, Motor Controller & Transformer Circuits	Class RK5, U/L listed, current limiting time delay, with 200K Amp interrupting rating.
Individual Equipment where fault current does not exceed 50 KA	Class K5, U/L listed, with 50 KA interrupting rating.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

B. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 16491

SECTION 16511

INTERIOR LIGHTING

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. Interior lighting fixtures, lamps, and ballasts.
2. Exit signs.
3. Lighting fixture supports.

B. Related Sections include the following:
1. Division 16 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Luminaire: Complete lighting fixture, including ballast housing if provided.

G. RCR: Room cavity ratio.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Ballast.
3. Energy-efficiency data.
4. Life, output, and energy-efficiency data for lamps.

5. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

   a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
   b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

   1. Wiring Diagrams: Power and control wiring.

   2. Perimeter moldings.

C. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture Schedule. Each sample shall include the following:

   1. Lamps: Specified units installed.
   2. Accessories: Cords and plugs.

D. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

E. Qualification Data: For agencies providing photometric data for lighting fixtures.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

H. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

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. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

E. Mockups: Provide interior lighting fixtures for room or module mockups, complete with power and control connections.

   1. Obtain Architect's approval of fixtures for mockups before starting installations.

2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

B. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Electronic Ballasts: Five years from date of Final Acceptance.

C. Special Warranty for T5 and T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: One year(s) from date of Final Acceptance.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

B. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to 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, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
3. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

E. Metal Parts: Free of burrs and sharp corners and edges.

F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

G. 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.

H. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

I. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

   a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is indicated.
   b. UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.

J. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. Electronic Ballasts: Comply with ANSI C82.11; rapid start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.

1. Sound Rating: A.
2. Total Harmonic Distortion Rating: Less than 10 percent.
3. Transient Voltage Protection: IEEE C62.41, Category A or better.
4. Operating Frequency: 42 kHz or higher.
5. Lamp Current Crest Factor: 1.7 or less.
6. BF: 0.85 or higher.
7. Power Factor: 0.98or higher.
8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Single Ballasts for Multiple Lighting Fixtures: Factory-wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

C. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.

D. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.

E. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.

1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.

a. High-Level Operation: 100 percent of rated lamp lumens.
b. Low-Level Operation: 30 percent of rated lamp lumens.

2. Ballast shall provide equal current to each lamp in each operating mode.
3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.98 or higher.

10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
11. Ballast Case Temperature: 75 deg C, maximum.

NOTE: Use of programmed start electronic ballast is not acceptable.

2.5 BALLASTS FOR HID LAMPS

A. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Sound Rating: A.
3. Total Harmonic Distortion Rating: Less than 15 percent.
4. Transient Voltage Protection: IEEE C62.41, Category A or better.
5. Lamp Current Crest Factor: 1.5 or less.
6. Power Factor: .90 or higher.
7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
8. Protection: Class P thermal cutout.
9. Retain subparagraph and associated subparagraphs below for bi-level ballasts.
10. Bi-Level Dimming Ballast: Ballast circuit and leads provide for remote control of the light output of the associated fixture between high- and low-level and off.

    a. High-Level Operation: 100 percent of rated lamp lumens.
    b. Low-Level Operation: 50 percent of rated lamp lumens.
    c. Compatibility: Certified by ballast manufacturer for use with specific bi-level control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.

11. Continuous Dimming Ballast: Dimming range shall be from 100 to 35 percent of rated lamp lumens without flicker.

    a. Ballast Input Watts: Reduced to a maximum of 50 percent of normal at lowest dimming setting.
    b. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.

B. Auxiliary Instant-On Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent light output.

2.6 EMERGENCY LIGHTING FIXTURES

A. General: Provide lighting fixtures, of sizes, types and ratings indicated; complete with, but not limited to, housings, energy efficient lamps, lamp holders, reflectors, energy-efficient ballasts, starters, and wiring.

B. Wiring: Provide wiring within fixtures for connection to branch circuit wiring.

C. Exit Fixtures - Battery Powered: Provide surface, wall, or ceiling mounted fixtures as indicated. Provide LED type lamps for normal and emergency operation, dual voltage (120/277 V.), Universal mounting, universal arrows. Furnish battery-powered unit with automatic charging, complete with nickel-cadmium battery which automatically connects low voltage lamp to battery power upon

loss, and disconnect upon restoration of normal AC supply. LED lamps shall fully outline 'Exit' text (backlit panels are not permitted).

D. Lighted Panels: Provide natural-finish, die-cast aluminum panels with permanent, red letters, 6" high, 3/4" stroke.

1. Furnish battery-powered unit with automatic charging, complete with nickel-cadmium battery which automatically connects LED lamps to battery power upon loss, and disconnects upon restoration of normal AC supply.

E. Unitized Battery Powered Fixtures:

1. General: Various fixture types are indicated below. Fixtures must comply with minimum requirements as stated herein.

2. Emergency Units: Provide battery powered, self-contained units and solid-state, UL listed, fully automatic charger and transfer/brownout circuit and low-voltage battery disconnect; full 3-year warranty plus 15-year prorated warranty.

a. Provide enclosure constructed in accordance with NEMA 1 standards.

b. Supply maintenance-free pure lead battery for operation capable of supply-connected load for minimum period as indicated on drawings to end voltage or 87-1/2% of nominal battery voltage.

c. Provide unit-mounted and/or remote-mounted head as indicated on the Drawings.

3. Accessories: Provide following accessories mounted on unit cabinet:

a. Unit test switch.

b. Voltmeter.

c. Ammeter.

d. AC "ON" pilot light.

e. Battery life expectancy alarm.

f. Heavy-duty wall mounting bracket.

g. Other options as required by NCDoI.

2.7 FLUORESCENT LAMPS

A. T8 rapid-start low-mercury lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500K, and average rated life 20,000 hours, unless otherwise indicated.

B. T8 rapid-start low-mercury lamps, rated 17 W maximum, nominal length of 24 inches (610 mm), 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 3500K, and average rated life of 20,000 hours, unless otherwise indicated.

C. T5 rapid-start low-mercury lamps, rated 28 W maximum, nominal length of 45.2 inches (1150 mm), 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 3000K, and average rated life of 20,000 hours, unless otherwise indicated.

D. T5HO rapid-start, high-output low-mercury lamps, rated 54 W maximum, nominal length of 45.2 inches (1150 mm), 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.

E. Compact Fluorescent Lamps: 4-Pin, low mercury, CRI 80 (minimum), color temperature 3500K, average rated life of 10,000 hours at 3 hours operation per start, [unless otherwise indicated.

1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).

2.8 HID LAMPS

A. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 65 and color temperature 4000 K.

B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000K.

C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.

2.9 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

B. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm)

E. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.10 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

A. Fixture Type: As indicated on drawings.

1. Basis-of-Design Product: As indicated on plans.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings:

1. Install a minimum of four ceiling support system rods or wires for each fixture to a structure member. Locate not more than 6 inches (150 mm) from lighting fixture corners.
2. Lay-in fixture shall be screwed to the main runners of the suspended ceiling track at all (4) four corners using sheet metal screws.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: 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 fixture chassis, including one at each end.

D. Adjust aimable lighting fixtures to provide required light intensities.

E. Connect wiring according to Division 16 Section "Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal. Contractor shall perform a test on each unit after it is permanently installed and charged for a minimum of 24 hours. Battery shall be tested for 90 minutes. The battery test shall be done 10 days prior to final inspection by State Construction Office.

B. 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.

C. Furnish copy of the test report to the State Construction Office.

END OF SECTION 16511

SECTION 16615

VOICE AND DATA COMMUNICATIONS SYSTEM

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. State Information Technology Guideline Specifications

1.2 SUMMARY

A. It shall consist of voice and data backbone pathways and cables, voice and data horizontal pathways and cables, and telephone and/or data outlets.

1.3 SUBMITTALS

Submit the following:

A. Product data for jack outlets, cables and patch panels.

B. Product certificates, acknowledged by the communication system manufacturers, certifying that the cables are suitable for the connected equipment as described in 'Quality Assurance' Article below.

C. Field test reports indicating and interpreting test results.

D. Maintenance data for cables to include in the "Operating and Maintenance Manual".

E. Upon completion of the project, Contractor is to prepare "As Built" documentation showing actual site conditions and installation as constructed.

All cabling systems will be documented in hard copy and CD Rom. These as-built drawings will provide documentation of the entire installed wiring system. This documentation will include a spreadsheet (Microsoft Excel compatible format), and be submitted on both CD rom and hard copy in the following format:

Building Name		
Telecom Room	Data Jack Number	Room Connected To
Room #	D-47	357

One hard copy of spreadsheet documentation shall be attached to rack in each room. Additionally, the contractor will provide three (3) copies of paper blueprint drawings marked with jack numbers. These as-built drawings will also be provided on CD Rom copy in Autocad.dwg format.

F. In addition to the engineering diagrams, record of field tests of System shall be provided by the contractor:

1.4 QUALITY ASSURANCE

A. Connected Equipment Manufacturer Certification: Where cables specified in this Section are used to provide signal paths for systems furnished under other contracts, obtain review of the cable characteristic and certification for use with the connected system equipment by the connected equipment manufacturers.

B. Testing Firm Qualifications: "Nationally Recognized Testing Laboratory" (NRTL) Listing: Provide materials that are listed and labeled.

C. The Terms "Listed" and "Labeled": as defined in the "National Electrical Code," Article 100.

D. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

E. FCC Regulations: Comply with FCC Part 68, Chapter 1, "US Code of Federal Regulations, "Title 47 for all telephone system wire and cable connection components.

F. Testing Firm's Field Supervisor Qualifications: A person currently certified by the International Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing.

G. Contractor shall provide a list of its project management staff and technical support staff to be assigned to this project together with their resumes and working experience.

H. Contractor shall utilize certified cable installers and technicians with approved vendor specific certification. Contractor shall supply certification documentation for cable installers.

I. Contractor shall state the nearest branch office and dealer's office in relation to the proposed site of the cabling system. If none, the location of the main office shall be stated.

J. Contractor shall state the nearest location of their principal support center. This center shall have permanently stationed support staff who are capable of providing technical support if required.

K. Comply with NFPA 70 "National Electrical Code" for components and installation.

L. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

M. Single-Source Responsibility: All cable, jack outlets and hardware equipment of each kind shall be the product of a single manufacturer.

N. Standards of Compliance: Comply with the following standards, as applicable:

1. ANSI/EIA/TIA-568 "Commercial Building Telecommunications Standard Cabling.
2. ANSI/TIA/EIA-569 - Commercial Building Standard for Telecommunications Pathways and Spaces.
3. ANSI/TIA/EIA-607 - Commercial Building Grounding/Bonding Requirements for Telecommunications.
4. ANSI/TIA/EIA-606 - Administrative Standard for the Telecommunications Infrastructure of Commercial Buildings.
5. BICSI-TDM Manuals - Building Industry Consulting Service International Telecommunications Distribution Methods Manuals.
6. ANSI - American National Standards Institute
7. UL Listed - Underwriter's Laboratories Listed
8. NEMA - National Electrical Manufacture's Association.

PART 2 - PRODUCTS

2.1 BUILDING WIRES

In general, the Building Contractor will be responsible for the purchase, installation, termination, testing, and documentation of all specified communications cable and the Telecommunications Office will be responsible for the acceptance testing of the contractor's installation. Specific Telecommunications Office and Building Contractor responsibilities are outlined in the sections below. All communications cable must meet or exceed the following cable specifications. Acceptable vendor cable part numbers are listed, however if substitutions are made the contractor must provide vendor cable specifications, which then must be approved by the Telecommunications Office before the cable is installed.

A. Standard Cable: minimum bundle to be installed to each communications outlet unless otherwise specified.

1. Voice Cable EIA/TIA 568 Standard:
   a. Category 6
   b. 4 Pair 24 Gauge Solid Copper
   c. Sheath color: Blue
   d. The following are acceptable cables:

2. 100 Mbps Data Cable:
   a. EIA/TIA 568 Standard

b. Category 6

c. 4 pair 24 Gauge Solid Copper

d. Sheath Color: Yellow

2.2 COMMUNICATION OUTLET BOX

A. Recessed outlet boxes will be used for voice, data, and video services where new wall is being constructed. Outlet boxes will be 4-" x 4-" x 2-1/8" deep and have a double gang plaster ring. Each outlet box will have one 1-" conduit and each conduit will have no more than two 90 degree bends between the outlet and the designated communications room or cable tray. If more than two 90 degree bends are required, a pull box must be installed and the locations of pull boxes shall be shown on the as-built drawings. The use of LB, LL, and LR fittings will not be approved. Outlets will not be looped in the same run of conduit.

2.3 VOICE/DATA OUTLETS

A. The communications wiring plan standard includes communications outlets in work areas in accordance with plans. All outlets in office spaces will be wired to support one voice and two data communications connections. In non-office locations, in addition to data connections, at least one outlet will include a voice connection. Wall telephone outlets shall be wired with one voice connection. All outlets will be designated on the building electrical floor plan.

B. Any additional service options or deviations from the following communications outlet standard must be coordinated with and approved by the Telecommunications Office.

C. All outlets will be labeled in accordance with the cable identification scheme.

D. All communications outlets must use the acceptable vendor communications outlet part numbers as listed. The following summarizes the components provided at each communications outlet.

E. Standard Telecommunication Component Products

a. Facepaltes: Hubbell Inline station IFP series Part no. IFP260W
b. Voice Jack: Hubbell Part No. HXJU80W (USOC wired)
c. Data jack Hubbell Part No.P630SR1G (for use at wall telephone outlets)
d. Dust Covers: Hubbell Part No. HXJDC25 (for use on all data connections)
e. "F' type bulkhead Hubbell Part No. SFFGOW (for use at faceplates with RG-6 coaxial cable)
f. Patch panel: Hubbell Part No. P648U category 6 patch panel (for horizontal data connections in each telecom room)
g. Patch Panel: Hubbell Part No. P624U Category 6 patch panel (for riser data connections)
h. Patch Panel: Hubbell Part No. UDX16ES to terminate RG-6 coaxial cables in telecom room

i. Wall mount hinged bracket: Hubbell Part No. HPWWB1U4 to hold Hubbell Part No.UDX18E patch panels in telecom room
j. Cable Management Device (Horizontal): Superior modular products part no CO3519 (front of rack starting in the top position of each rack and between each patch panels in racks carrying horizontal data connections)
e. Cable management Device (vertical) Superior Modular Products Part no. AR24)sodes of all racks at 12" intervals)
f. Commscope 5781/2227V (CATV/CATVP) RG-6 coaxial station cable (for video connections).
g. Category 6 cable for data (white)
h. Category 5E cable for voice (Blue)
i. Power strip Homaco par tno PS-48-20A-10P

2.4 TERMINATION LABELS

A. Shall conform to ANSI/TIA/EIA-606. Labels will have pressure sensitive, permanent acrylic type adhesive.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation shall include the specified termination, testing, and documentation of all cable. The contractor shall neatly bundle all cables in the closet and label each cable to indicate floor and outlet number as specified below. All cable shall be labeled both at the termination point in the closet and at the wall plate at the wall outlet. In addition, the contractor shall conduct tests outlined below for all cable. The contractor shall perform testing on all twisted pair copper cable as documented in the EIA/TIA 568 Standard TSB 36 and 40 Bulletins.

B. The Owner shall witness acceptance testing. All cabling failing to meet the stated minimum specifications shall be replaced by the contractor at no cost to the Owner.

3.2 EXAMINATION

A. Examine raceways and other elements to receive cable for compliance with cable installation requirements. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Install cable as indicated, according to manufacturer's written instructions and in compliance with EIA/TIA 569.

B. Install transmission media without damaging conductors, shield, or jacket.

C. Do not bend cable, in handling or installation, to smaller radii than minimum recommended by manufacturer.

D. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

E. Pull cables simultaneously where more than one is being installed in same raceway.

F. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.

G. Use pulling means, including fish tape, cable, rope, and basket weave wire/cable grips that will not damage media or raceway.

H. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.

I. The length of each horizontal category-5 cable from telecommunication closet to data outlet shall not exceed 295 feet.

J. Surface mounted raceways and conduit shall be EMT or Rigid as per section 16110.

K. Use splice and tap connectors that are compatible with cable material.

Make no splices except at indicated splice points.

L. Bond shields and drain conductors to ground at only one point in each circuit.

1. Connect components to wiring system and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals according to torque specified in UL Standard 486A.

M. All vertical and horizontal metallic distribution systems must be grounded in accordance with National Electric Code.

N. Cable Identification:

1. All cable labels shall be produced with a professional label maker.

2. All cable shall be labeled both on the outlet and the patch panel with an alpha/numeric identification code using the following format:

3. (T-1) indicates telephone one (T-2) indicates telephone two (D-1) indicates data one, (D-2) indicates data two, (V-1) indicates video one, (F-1) indicates fiber one, etc.

4. If more than one room is used, for example Room B, then this will be indicated by a permanent label on the communications outlet. Ex. A-T1, A-D1, A-V1, B-T1, B-D1, B-V1.

5. Any exceptions to this labeling scheme, for example unique media types, will need to be coordinated with a representative from the Telecommunications

office. Labels will be positioned directly next to appropriate jack on faceplate.

6. The Building communications contractor will be responsible for the purchase and installation of all communications cable as specified. Installation will include the specified termination, testing, and documentation of all cable. The contractor will need to follow all appropriate installation procedures as outlined in TIA/EIA 568A/B and TIA/EIA 569 standards including correct bending radius, and maintaining the appropriate twists in the pairs. Contractor shall also follow TIA/EIA 606 and TIA/EIA 607 standards. The contractor will neatly bundle all cables in the room and label each cable to indicate floor and outlet number as specified. All cable will be labeled both at the termination point in the room and on the wall plate at the wall outlet. In addition to the bundle of installed cables the contractor will provide a pull string to each outlet for future cable installations. The contractor will conduct standard compliance tests of all cable including tests for continuity and pair reversal. The contractor will perform this testing on 100 percent of cabling to certify that the cable and termination meets the established specifications as documented in the standards noted above.

7. The State IT Department will perform acceptance testing. This testing may be done in conjunction with testing being performed by the communications contractor. All cabling failing to meet the TIA/EIA current published standards will be replaced by the contractor at no cost to the university.

8. All cable runs, regardless of media type, shall be able to reach any communications room wall. An additional 20 feet of slack cable shall be neatly hidden in telephone room cable tray. Cable within a room will be bundled and terminated via standard Category 5 Enhanced compliant patch panels, as detailed above, or special vendor equipment as indicated below. Cable bundles shall be secured using Velcro style tie wraps. Contractor shall not use any traditional plastic tie wraps. All patch panels will be mounted in 19" racks. All wiring of patch panels will begin from the top down in racks, and the mounting of hub equipment will begin from the bottom up. All cable termination points will be labeled to indicate room, room outlet, and terminal drop number as specified.

3.4 FIELD QUALITY CONTROL

A. Testing Firm: Provide the services of a qualified testing firm to perform specified field quality control testing.

B. Testing: Upon installation of cable and before energizing, demonstrate product capability and compliance with requirements.

C. Tools and test equipment:

1. The Contractor will provide all tools and test equipment required for installation and testing work. Test equipment will be maintained in accurate calibration and will display the dates of the last calibration and next scheduled calibration.

2. The Contractor is responsible for performing all tests indicated.

3. For all tests, the Designer must be present at the beginning of testing and at such times as the Designer deems appropriate.

4. The Contractor shall be responsible for correcting any problems or defects discovered during testing.

D. Acceptance Criteria:

1. The Designer will verify that all required activities have been performed in a final joint walk-through with the Contractor prior to system acceptance.

2. There shall be no provisions for automatic acceptance. A phased acceptance test may be performed; however, acceptance of any phase is conditional on the acceptance of the project as a whole. Acceptance testing/demonstration shall only occur based on the written notification to the Contractor from the Designer. The following criteria must be met:

a. All cables have been tested and shown as meeting all specifications to the satisfaction of the Owner. All test reports required shall have been submitted and approved by the Designer.

b. All outlets are completely installed and operational in the specified locations.

c. All required patch panels are installed and operational.

d. All patch cables, cross connects, and extension cables have been delivered.

e. Final as-built documentation has been provided by the Contractor.

f. Training and tools have been provided to the Owner cable management personnel in the maintenance and use of the installed cabling systems.

g. The site is clean and neat, ready for permanent use by the Owner.

h. All fire-stops have been installed.

E. Correct malfunctioning items and retest to demonstrate compliance; otherwise, remove and replace with new items and retest.

F. Copper Cable Procedures: Inspect for physical damage and test cable for continuity and shorts. Use time domain reflectometer with strip chart recording capability and anomaly resolution to within 12 inches (300 mm) in runs up to 1000 feet (300 m) in length. Test cable segments for faulty connectors, splices, terminations, and the integrity of the cable and its component parts.

G. Wire mapping shall be done to ensure proper wiring and connectivity. Test for:

1. Continuity, end-to-end.

2. Shorts between any two or more conductors.

3. Crossed pairs.

4. Reversed pairs.

5. Split pairs.

6. Other mis-wirings.

7. Document as Pass/Fail.

H. Bi-Directional NEXT. Near-end crosstalk (NEXT) shall be tested on all six pair combinations in each four pair cable. Tests for NEXT shall be performed from both the work area outlet location and link origination point.

3.5 CLEANING

A. Upon completion of system installation, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasion. Remove debris from outlet boxes prior to installing devices.

3.6 DEMONSTRATION

A. Operate systems to demonstrate proper functioning. Replace malfunctioning items.

B. Train Owner's maintenance personnel on procedures and schedules for start-up and shutdown, troubleshooting, servicing, and preventive maintenance.

C. Review data in operating and maintenance manuals.

D. Schedule training with Owner, through the Designer, with at least ten (10) days' advanced notice.

3.7 SYSTEM WARRANTY

A. Contractor shall provide a five (5) year warranty for both products and labor.

END OF SECTION 16615

SECTION 16632

SOLAR PHOTOVOLTAIC SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section includes an engineered solar photovoltaic system of prefabricated components utilizing solar energy for conversion to electrical power.

B. The General Provisions of the Contract, including General and Supplementary Conditions, and Division 1, apply to the work specified in this Section.

C. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of a complete and operational grid connected solar photovoltaic system as shown or indicated on the drawings and/or as specified. The purpose of this system is to reduce the power demand from the electric utility.

D. Equipment specified herein is intended to provide specific functional and operational characteristics. It is the responsibility of the PV Contractor to provide all features and functions as outlined in these specifications.

E. It shall be the responsibility of the PV Contractor to obtain all required approvals and certifications from authorities having jurisdiction.

1.2 RELATED SECTIONS

A. Section 16050 – Basic Electrical Materials and Methods

B. Section 16130 – Raceways and Conduits

C. Section 16120 – Conductors and Cables

D. Section 16075 – Electrical Identification

E. Section 16060 – Grounding

1.3 REFERENCES

A. UL 1703 Standard for Safety for Plat-Plate Photovoltaic Modules and Panels, 2nd Edition, 1993

B. IEEE 928 – 1986 IEEE Recommended Criteria for Terrestrial Photovoltaic Power Systems

C. IEEE 929 – 1988 IEEE Recommended Practice for Utility Interface of Residential and Intermediate Photovoltaic Systems

D. IEEE 1262 – 1995 IEEE Recommended Practice for Qualification of Photovoltaic Modules

E. IEEE 1374 Guide for Terrestrial Photovoltaic Power System Safety

F. NFPA 70 National Electrical Code, 2006 Edition

1.4 DEFINITIONS

A. Array: A mechanically integrated assembly of modules or panels with a support structure and foundation, tracking, thermal control, and other components, as required, to form a direct-current power-producing unit

B. Blocking Diode: A diode used to block reverse flow of current into a photovoltaic source circuit.

C. Interactive System: A solar photovoltaic system that operates in parallel with and may be designed to deliver power to another electric power production source connected to the same load. For the purpose of this definition, an energy storage subsystem of a solar photovoltaic system, such as a battery, is not another electric power production source.

D. Inverter: Equipment that is used to change voltage level or waveform, or both, of electrical energy. Commonly, an inverter (also known as a power conditioning unit or power conversion system) is a device that changes direct-current input to an alternating-current output. Inverter Input Circuit: Conductors between the inverter and the photovoltaic output circuits for grid-connected systems.

E. Inverter Output Circuit: Conductors between the inverter and the service equipment or another electric power production source, such as a utility, for grid-connected systems. Module: The smallest complete, environmentally protected assembly of solar cells, optics, and other components, exclusive of tracking, designed to generate direct-current power under sunlight.

F. Panel: A collection of modules mechanically fastened together, wired, and designed to provide a field-installable unit.

G. Photovoltaic Output Circuit: Circuit conductors between the photovoltaic source circuit(s) and the power conditioning unit.

H. Photovoltaic Power Source: An array or aggregate of arrays that generates direct-current power at system voltage and current.

I. Photovoltaic Source Circuit: Conductors between modules and from modules to the common connection point(s) of the direct-current system.

J. PV Contractor: The contractor with the primary responsibility of providing and installing the photovoltaic system. The PV Contractor may be a subcontractor to the electrical contractor or the general contractor, who has the ultimate responsibility of providing and installing the photovoltaic system.

K. Solar Cell: The basic photovoltaic device that generates electricity when exposed to light.

L. Solar Photovoltaic System: The total components and subsystems that, in combination, convert solar energy into electrical energy suitable for connection to a utilization load.

1.5 SYSTEM DESCRIPTION

A. Design requirements.

1. The system shall be a grid-connected interactive system.

2. Multiple inverters will be allowed.
3. The system shall be a flat-plate system.
4. The system shall be a fixed-tilt system.
5. The system shall use crystalline silicon material. Amorphous silicon is not acceptable.
6. The output of the solar photovoltaic system shall be connected to the building premises wiring system in accordance with NEC.
7. The power output of the solar photovoltaic system shall connect to 208/120-volts, 3-phase electrical panel that is a part of the building premises wiring system.
8. The rated open circuit voltage of the photovoltaic power source shall be at least 48 volts dc and shall not exceed 600 volts dc.
9. Storage batteries will not be used.
10. The system shall have a display, located as shown on the drawings and visible to the public, indicating the following:
    a. The voltage output of the array.
    b. The current output of the array.
    c. The power output of the system.
    d. The system shall meet the requirements of IEEE 928, IEEE 929 and IEEE 1374.
    e. The array shall be mounted on an architectural frame. Refer Architecture plans.

B. Performance Requirements

1. The nominal power rating of the solar photovoltaic system shall be at least three (3) kW.
2. The full power output of the solar photovoltaic system, taking system losses into account, shall be continuously delivered to the premises wiring system to reduce the power demand on the utility system.
3. Emergency back-up of the utility system is not required.
4. In accordance with NEC, the power output from the solar photovoltaic system shall be automatically disconnected from all unground conductors of the building premises wiring system upon loss of utility system voltage at the point of connection, and shall not reconnect to the premises wiring system until such voltage is restored. Upon restoration of the utility system voltage, the reconnection of the photovoltaic system shall be automatic.

1.6 SUBMITTALS

A. Submittals required in this section shall conform to and be submitted in accordance with the General Conditions, Division 1, and Division 16 Section 16.

B. Product Data: The contractor shall submit an equipment list and data sheet on all components of the system.

C. The contractor shall submit information on other materials as requested by the Architect. Product submittals shall include, but not be limited to, the following:

1. Photovoltaic modules

2. Module support system

3. Inverters

4. Wiring and conduit

D. Shop Drawings: The contractor shall submit a drawing showing all components of the system including all electrical ratings, wiring, disconnects and protection devices.

1.7 QUALITY ASSURANCE

A. Qualifications

1. Bidders who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, and meet the other requirements herein described will be disqualified.

2. The contractor, as a business entity, shall be an authorized and designated representative of the solar panel and inverter manufacturers, with full warranty privileges, and shall have been actively engaged in the business of selling, installing, and servicing solar photovoltaic systems for a period of at least 5 years.

3. Recently formed companies are acceptable only if specific pre-approved is requested, and granted by the Engineer, based on experience of key personnel, current and completed projects, and all licensing requirements are met 10 working days prior tot the bid date.

4. The contractor shall have an office within 350 miles of the job site staffed with trained technicians who are qualified to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up and perform a 100 percent operational audit of all installed devices, to instruct the Owners representatives in the proper operation of the system, and to provide service throughout the warranty period.

5. The contractor shall be capable of dispatching technicians to repair a system within seventy-two hours of a service request.

6. The contractor shall be fully experienced in the design and installation of the solar photovoltaic system herein specified, and shall furnish with the bid an itemized list of the installations of the type specified herein. The list shall include the name of the project, date of completion, the size (power rating) of

the system, the name, and telephone number of the person to contact for reference. This list must contain at least two (2) projects within a 350-mile radius of the school district to allow school administration officials to visit the job site for review of the system installation and service.

7. The contractor shall have a full-time employee who shall be responsible for the design of the system submitted and shall sign all submittal drawings.

8. The contractor shall not have any grievances or complaints of record regarding workmanship, code compliance, or service response with the Owner. A contractor that has litigation of this type in process is unacceptable.

9. The Owner may make such investigations as he deems necessary to determine the ability of the contractor to perform the work, and the contractor shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such contractor fails to satisfy the Owner that such contractor is properly qualified to carry out the obligations of the contract and to complete the work contemplated therein. Conditional bids will not be accepted.

10. The contractor shall employ full time technicians and installers. The manufacturer shall maintain a full time factory employed service staff for product support and service.

11. The ability of any contractor to obtain plans and provide a performance bond shall not be regarded as the sole qualification of such contractor's competency and responsibility to meet the requirements and obligations of the contract.

12. Before using the bid of a subcontractor as part of his bid, the General Contractor shall satisfy himself that the proposed subcontractor can satisfy all of the requirements expressed above. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such contractor fails to satisfy the Owner that the contractor and/or any subcontractor he proposes can properly qualify to carry out the obligation of any part of the contract, and to complete the work contemplated therein.

13. The Owner reserves the right to reject the bid of any contractor who has previously failed to perform properly, or complete on time, contracts of a similar nature.

1.8 DELIVERY, STORAGE, AND HANDLING.

A. Packing, Shipping, Handling, and Unloading: All system components shall be handled in accordance with manufacturer's instructions and recommendations.

B. Storage and Protection: All system components and materials shall be protected from physical damage and from the elements in accordance with manufacturer's recommendations until installed. Failure to properly protect the equipment shall serve as reason to reject the equipment.

1.9 WARRANTY

A. Special Warranty: The PV Contractor shall warranty the entire solar photovoltaic system for a period of at least 5 years after installation.

B. The Inverters shall have a manufacturer's warranty of at least 5 years.

C. The photovoltaic panels shall have a manufacturer's warranty of at least 10 years.

1.10OWNER'S INSTRUCTIONS

A. Upon completion of the installation, and prior to final inspection, the Contractor shall furnish five (5) copies of as-built drawings. Provide one reproducible vellum and four prints. In addition to this, the contractor shall furnish four (4) copies of a complete operating and maintenance manual listing the manufacturer's name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Provide a parts list with manufacturer and model number for commonly replaced parts. Include complete instructions for the inspection, testing and maintenance of the system.

B. The contractor shall conduct formal on-site training sessions. It shall be the responsibility of the contractor to coordinate time and location of training sessions with the Owner. Provide documented general instruction as follows:

1. Provide instruction to the maintenance personnel to include the location, inspection, maintenance, testing, and operation of all system components.

2. Provide instruction to designated personnel on the functions and operation of the system including capabilities, limitations, monitoring, and the meaning of status messages. State the proper procedure for routine maintenance, and request for service.

1.11MAINTENANCE

A. Maintenance Service: The PV Contractor shall provide regular scheduled maintenance, as recommended by the manufacturer of each major component, for a period of at least one year starting at system start-up.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Inverters

1. Trace SW-PV series or equivalent

B. Panels: All panels shall be from the same manufacturer and shall have the same electrical characteristics.

1. ASE Americas, Inc. ASE-300-DG/50 or equivalent.

2.2 MATERIALS

A. All materials furnished under this Contract shall be new, free from defects of any kind, of the quality and design hereinafter specified, and shall conform to the standards of Underwriter's Laboratories Inc., except for equipment which U.L. does not list or provide label service.

2.3 COMPONENTS

A. Panels

1. Marking: In accordance with NEC, panels shall be marked with identification of terminals or leads as to polarity, maximum overcurrent device rating for panel protection, and with the panel ratings for the following:

   a. Open-circuit voltage

   b. Operating voltage

   c. Maximum permissible system voltage

   d. Operating current

   e. Short-circuit current

2. Maximum power

   a. The panels shall utilize crystalline silicon solar cells. Amorphous silicon will not be accepted.

   b. The front of the panels shall be low-iron tempered glass with a minimum thickness of 1/8 inch.

   c. The back of any panel visible to the public from the rear shall be tempered glass with a minimum thickness of 1/8 inch. The back of panels not visible to the public from the rear may be ethylene vinyl acetate (EVA). This project calls for some or all of the panels to be mounted near or over an architectural feature that makes them visible from the rear.

   d. The panels shall be equipped with wired-in bypass diodes to prevent reverse current flow.

   e. Each panel shall be equipped with a junction box designed to accept conduit. Field connections shall be made within this junction box.

   f. The panels shall have an extruded anodized aluminum frame.

   g. The panels shall meet the requirements of IEEE Standard 1262-1995.

   h. The entire array shall fit into an area no larger than 120 feet long by 6.5 feet high.

3. Panel Support Structure

   a. The array shall be mounted on an architectural frame. Refer to the architectural drawings for the exact frame size.

   b. If the panels cannot be made to fit into the architectural frame, then the PV contractor shall pay the expenses involved in redesigning the frame.

4. Inverters

   a. The inverters shall be grid commutated, synchronous invertes listed for direct connection to a utility

b. The output of each inverter shall be a 60 Hz sine wave at either 120-volts RMS or 240-volts RMS

c. The operating efficiency of the inverters shall be at least 90% throughout the majority of the operating range.

d. Each inverter shall have protection against overloads, short circuits, and over temperature.

e. The inverters shall automatically shut down when the output of the array reaches or drops below a shutdown threshold level. The inverters shall automatically start operation when the output of the array reaches or exceeds a starting threshold level.

f. When shut down, the power draw of each inverter shall not exceed 5 watts.

PART 3 – EXECUTION

3.1 ACCEPTABLE INSTALLERS

A. The PV Contractor shall install the array, inverters, and all dc wiring. Either the PV Contractor or the electrical contractor shall install the remaining components and the ac wiring. The electrical contractor shall make final connections to the building premises wiring system.

3.2 EXAMINATION

A. Site Verification of Conditions; Before submitting a proposal, each bidder shall examine all plans and specifications relating to the work and become fully informed of the extent and character of the work required, including all required utilities. No consideration will be granted for any alleged misunderstanding of the materials to be furnished or the amount of work to be done, it being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans or required by nature of the site of which may be fairly implied as essential to the execution and completion of any and all parts of the work.

3.3 INSTALLATION

A. Wiring Methods: All raceways, wiring, and devices shall meet the requirements of NEC. All ac and dc siring shall be enclosed in conduit. Additionally, all raceways, wiring, and devices shall meet the requirements of all other applicable sections of these specifications.

B. Grounding: The photovoltaic power source shall be grounded in accordance with NEC.

C. Marking: In accordance with NEC, the installer shall provide a marking at an accessible location at the disconnecting means for the photovoltaic power source. This marking shall specify the following:

1. The photovoltaic power source rated operating current.

2. The photovoltaic power source rated operating voltage.

3. The photovoltaic power source rated open-circuit voltage.

4. The photovoltaic power source rated short-circuit current.

3.4 CONSTRUCTION

A. Interface with Other Work: The PV Contractor shall coordinate his work with that of the other contractors to provide a complete, functional system.

3.5 FIELD QUALITY CONTROL

A. Field Observation: The work of the contractor shall be subject to the observation of the architect and engineer at any time. The engineer and/or architect may document observations made on the job site. Any specification violations or problems shall be addressed and corrected in accordance with the contract documents.

END OF SECTION 16632

SECTION 16810

TESTING AND START-UP

PART 1 - GENERAL

1.1 DESCRIPTION

A. Upon completion of the installation and at such time as designated by the Designer, field test shall be made on all equipment, materials and systems in accordance with the manufacturer's recommendations, testing standards of the Institute of Electrical and Electronic Engineers and the American National Standards Institute.

B. Tests shall be conducted in the presence of the Designer for the purpose of demonstrating the equipment or systems' compliance with specifications. In general, all electrical and mechanical tests shall demonstrate to the Designer that the entire installation is functioning properly and that all circuits, including power, control, instrumentation, relaying and communication, will function properly and as specified.

C. Furnish, install and maintain all tools, instruments, material, test equipment, test connections and power. Furnish all personnel including supervision and "stand-by" labor required for the testing, setting, and adjusting of all electrical facilities and component parts including putting the above into operation.

D. Tests shall be made with proper regard for the protection of equipment and personnel.

E. After equipment has been tested, checked for operation, and accepted by the Designer, equipment shall be protected from subsequent testing of other equipment and systems.

F. Record all test values of equipment, giving both "as-found" and "as-left" conditions. All tests shall be completely documented stating time of day, date, temperature, conditions, and all pertinent test information.

G. The witnessing of any test by the Designer does not relieve the Contractor of warranties for material, equipment, and workmanship, as specified in the General Conditions.

H. Current transformers not used shall be short-circuited at the respective terminal boards to eliminate a hazardous condition.

I. Control circuits shall be checked for conformance with the wiring diagrams furnished by the Designer and manufacturers.

1.2 SUBMITTALS

A. Equipment Test Values: Three certified copies of start-up and test data shall be submitted to the Designer for review and approval.

B. Notify the Designer in writing minimum four days prior to final inspection certifying that all insulation resistance tests have been performed and include meg readings for each panel.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SPECIFIC TESTS

A. The following tests shall be made when applicable to the equipment installed:

1. Insulation Resistance Tests: Shall be made on all electrical equipment, using a self-contained instrument such as the direct- indicating ohmeter of the generator type, or "Megger" such as manufactured by J. G. Biddle Company, or approved equal. Phase conductors and neutrals shall be tested as installed and before connections are made.

a. The following test voltages shall be applied for one minute, except where otherwise specified herein, in accordance with the procedure recommended by the manufacturer of test equipment and as specified herein.

Conductor Size (AWG)	Minimum Rated Circuit Voltage	Megger Voltage (d-c)	Megger Reading
#6 and smaller	600 volts	500 volts	1,000,000 ohms
#4 and larger	600 volts	500 volts	250,000 ohms

b. Insulation resistance tests shall be applied to power and control wires and cables. Insulation resistance values shall be at least 75% of shop test records.

c. Power and Control Wires and Cables. Before making terminal connections of each power and control wire and cable, an insulation resistance test of each cable shall be made and recorded for official record purposes. Each conductor of multi-conductor power and control cable shall be tested individually, to each other and to ground. Single conductor power and control cables shall be tested to ground. Where several single conductors are run in the same conduit, insulation resistances shall be obtained as for multi-conductor cables. If the values of resistance obtained do not meet the specified requirements, further tests shall be made to isolate the poor insulation. If the insulation resistance cannot be raised to meet minimum requirements, the entire cable involved shall be replaced and new cable installed and tested.

d. After connection of utilization equipment, devices, fixtures, etc. to panel, disconnect neutral feeder from bar in panel and meg between neutral bar and grounded enclosure. The reading shall be minimum 250,000 ohms. If resistance value does not meet minimum, further tests shall be made to isolate the low readings and the situation shall be corrected, reconnected and retested until minimum 250,000 ohms resistance from neutral bar to grounded enclosure can be achieved.

B. Miscellaneous Tests:

1. Wiring: All control circuits shall be checked for continuity and conformance with the wiring diagrams furnished by the Designer and manufacturers.

2. Polarity Tests: Continuity and polarity tests shall be made on all current and potential transformers to determine whether the polarity is as indicated on the drawings, and the circuit is continuous.

3. Phasing Tests: Phases of all switchgear and power cables shall be identified by stenciling the switchgear and tagging the cables with approved tags, so that the phases can be identified for connecting to proper phase sequence.

C. GROUND SYSTEM TESTING

1. Upon completion of installation of the electrical grounding and bonding systems, the ground resistance shall be tested with a ground resistance tester. Where tests show resistance-to-ground is over 25 ohms, appropriate action should be taken to reduce the resistance to 25 ohms, or less, by driving additional ground rods. (The compliance should be demonstrated by retesting.)

D. CIRCUIT BREAKER TESTS

1. For serves 1000 amperes and larger, the following tests should be performed on the service circuit breakers and the distribution circuit breakers. Testing shall be performed by a qualified factory technician at the job site. All readings shall be tabulated:

a. Phase tripping tolerance (within 20% of U/L requirements).

b. Trip time (per phase) in seconds.

c. Instantaneous trip (amps) per phase.

d. Insulation resistance (in megaohms) at 100 volts (phase to phase, and line to load).

E. GROUND FAULT PROTECTION SYSTEM

1. The ground fault protection on the new circuit breakers (if provided) shall be performance tested in the field and properly calibrated and set in accordance with the coordination study.

F. DOCUMENTATION

1. All tests specified shall be completely documented indicating time of day, date, temperature and all pertinent test information.

2. All required documentation of readings indicated above shall be submitted to the engineer prior to, and as one of the prerequisites for, final acceptance of the project.

END OF SECTION 16810

COMPENSATION FOR REST AREA/VISITOR CENTER CONSTRUCTION

COMPENSATION FOR GENERAL CONSTRUCTION OF REST AREA/VISITOR CENTER BUILDING

The work of furnishing materials and constructing the Rest Area/Visitor Center Building in accordance with the plans and specifications, completed and accepted, will be paid for at the contract unit price for "General Construction of Rest Area/Visitor Center Building". Such price and payment will be full compensation for all work of constructing the Rest Area/Visitor Center building including but not limited to furnishing all transportation, materials, labor, tools, equipment, fees and incidentals necessary to complete the work. Payment will be made under:

"General Construction of Rest Area/Visitor Center Building" ..... Lump Sum

COMPENSATION FOR PLUMBING INSTALLATION FOR REST AREA/VISITOR CENTER BUILDING:

The work of furnishing and installing plumbing for the Rest Area/Visitor Center Building in accordance with the plans and specifications, completed and accepted, will be paid for at the contract unit price for "Plumbing Installation for the Rest Area/Visitor Center Building". Such price and payment will be full compensation for all plumbing work for the Rest Area/Visitor Center building including but not limited to furnishing all transportation, materials, labor, tools, equipment, fees and incidentals necessary to complete the work. Payment will be made under:

"Plumbing Installation For Rest Area/Visitor Center Building" ..... Lump Sum

COMPENSATION FOR HVAC INSTALLATION FOR THE REST AREA/VISITOR CENTER BUILDING:

The work of furnishing and installing Heating, Ventilating, and Air Conditioning for the Rest Area/Visitor Center Building in accordance with the plans and specifications, completed and accepted, will be paid for at the contract unit price for HVAC Installation for the Rest Area /Visitor Center Building". Such price and payment will be full compensation for all work of heating, ventilating, and air conditioning installation in the Rest Area /Visitor Center building including but not limited to furnishing all transportation, materials, labor, tools, equipment, fees and incidentals necessary to complete the work. Payment will be made under:

" HVAC Installation for the Rest Area/Visitor Center Building" ..... Lump Sum

COMPENSATION FOR ELECTRICAL INSTALLATION FOR THE REST AREA/VISITOR CENTER BUILDING:

The work of furnishing and installing all electrical work in the Rest Area/Visitor Center building in accordance with the plans and specifications, completed and accepted, will be paid for at the contract unit price for "Electrical Installation for the Rest Area/Visitor Center Building". Such price and payment will be full compensation for all electrical work for the Rest Area/Visitor Center building including but not limited to furnishing all transportation, materials, labor, tools, equipment, fees and incidentals necessary to complete the work. Payment will be made under:

"Electrical Installation For The Rest Area/Visitor Center Building" ..... Lump Sum

COMPENSATION FOR CONSTRUCTION OF
THE STORAGE BUILDING:

The work of furnishing and constructing the Storage Building in accordance with the plans and specifications, when completed and accepted, will be paid for at the contract lump sum price for " Storage Building". Such price to be considered as full payment for this work, including, but not limited to, furnishing all labor, materials, and any other incidentals necessary or required to complete the work. Payment will be made under:

Storage Building ..... Lump Sum

COMPENSATION FOR CONSTRUCTION OF
THE MAINTENANCE BUILDING:

The work of furnishing and constructing the Maintenance Building in accordance with the plans and specifications, when completed and accepted, will be paid for at the contract lump sum price for " Maintenance Building". Such price to be considered as full payment for this work, including, but not limited to, furnishing all labor, materials, and any other incidentals necessary or required to complete the work. Payment will be made under:

Maintenance Building ..... Lump Sum