

SP- 097044
(New)



**SPECIAL PROVISIONS
FOR
STUART DEPOT COMMUNITY BUILDING**

**Guthrie County
STP-ES-7457(604)--8I-39**

**Effective Date
August 21, 2012**

THE STANDARD SPECIFICATIONS, SERIES 2009, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

**SECTION 01 1000
SUMMARY AND ADDITIONAL INSURANCE**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
1. Project information.
 2. Work covered by Contract Documents.
 3. Access to site.
 4. Work restrictions.
 5. Specification and drawing conventions.
 6. Additional Insurance Requirements

1.2 PROJECT INFORMATION

- A. Project Identification: Stuart Depot Community Building
Phase 3
Project No. STP-ES-7457(604) - - 8I - 39
GUTHRIE COUNTY
1. Project Location: Stuart Depot
204 E. Front Street
Stuart, IA 50250
- B. Contracting Authority: City of Stuart Iowa
Dick Cook, Mayor
119 E. Front Street
Stuart, IA 50250
1. Contracting Authority's Representative: Ashraf Ashour, Stuart City Administrator
Stuart City Hall
119 E. Front Street
Stuart, IA 50250
- C. Engineer/Architect: Douglas J. Steinmetz Architect
4121Timberview Drive
Cedar Rapids, IA 52411
1. Where the term "Engineer" appears in The Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction, Special Provisions or any other Contract Document substitute the term "Architect" when referring to the design professional in responsible charge of the project.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of the Project is defined by the Contract Documents and consists of the following:
1. The project includes rehabilitation of the National Register Listed Stuart Depot including but not limited to providing new utility services, storm drainage system, sitework improvements such as walkways, parking, and landscaping, interior and exterior concrete flat work, minor masonry work, rough and finish carpentry, building insulation, gutters and downspouts, doors, repair of historic windows including some custom replacement, finish hardware, gypsum drywall, wood and moisture resistant flooring, interior and exterior painting, toilet accessories, complete new mechanical, electrical and plumbing systems and other work as need to provide a functional community building at the completion of the project.
- B. Type of Contract.
1. Project will be constructed under a single prime contract.

1.4 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Contracting Authority's right to perform work or to retain other contractors on portions of Project.
- B. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
1. Limits: Confine construction operations to area within approximately 20 feet of building perimeter.

2. Rail Road Tracks, Driveways, Walkways and Entrances: Keep railroad tracks, driveways and entrances serving premises clear and available to all trains, Contracting Authority, Contracting Authority's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
 - C. Condition of Existing Building: Maintain existing building in a weathertight and secure condition throughout construction period. Repair damage caused by construction operations.
- 1.5 WORK RESTRICTIONS
- A. Work Restrictions, General: Comply with restrictions on construction operations.
 1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.
 - B. Nonsmoking Site and Building: Smoking is not permitted within the building or on the site.
 - C. Controlled Substances: Use of tobacco products and other controlled substances within the existing building or on the Project site is not permitted.
- 1.6 SPECIFICATION AND DRAWING CONVENTIONS
- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
 - B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
 - C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:
 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Keynoting: Materials and products are identified by reference keynotes on the drawings.
- 1.7 ADDITIONAL INSURANCE PROVISIONS
- A. Insurance required by this project shall be written for not less than the following limits or greater if required by law or other provisions of this project.
 1. See ADDITIONAL INSURANCE REQUIREMENTS-CITY OF STUART found at the end of this section.
 - B. Certificates of Insurance acceptable to the Contracting Authority shall be filed with the Contracting Authority prior to commencement of the Work. These Certificates and the insurance policies required shall contain a provision that coverage afforded under the policies will not be canceled or allowed to expire until at least 30 days prior written notice has been given to the Contracting Authority. If any of the foregoing insurance coverages are required to remain in force after final payment and are reasonably available, an additional certificate evidencing continuation of such coverage shall be submitted with the final Application for Payment. Information concerning reduction of coverage shall be furnished by the Contractor with reasonable promptness
- PART 2 - PRODUCTS (Not Used)
- PART 3 - EXECUTION
- 3.1 ADDITIONAL INSURANCE REQUIREMENTS - CITY OF STUART
- A. The Contractor shall purchase and maintain such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations under the contract, whether such operations be by the Contractor or by any subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

1. Claims under Worker's Compensation, Disability benefit, and other similar employee benefit acts;
 2. Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employee;
 3. Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employee.
- B. The insurance to be maintained by Contractor shall be written as follows:
1. Workers' Compensation and Employers Liability Insurance as prescribed by Iowa law minimum limits shown below covering Employers Liability:

Bodily Injury by accident	\$500,000 each accident
Bodily Injury by disease	\$500,000 each accident
Bodily Injury by disease	\$500,000 policy limit
 2. Commercial General Liability Insurance Combined Single Limits shown below covering Bodily Injury, Property Damage and Personal Injury:

General Aggregate Limit	\$2,000,000
Products-Completed Operations	
Aggregate Limit	\$2,000,000
Personal and Advertising Injury	
Limit	\$1,000,000
Each Occurrence Limit	\$1,000,000
Fire Damage Limit	
(for any one fire)	\$50,000
Medical Damage Limit	
(any one person)	\$5,000
 3. This insurance must include the following features:
 - Coverage for all premises and operations. The policy shall be Endorsed to provide the Aggregate Per Project Endorsement.
 - Personal and Advertising Injury.
 - Operations b independent contractors.
 - Contractual Liability coverage.
 - Coverage for property damage underground or damaged by explosion or collapse (XCU).
 4. Railroad Protective Endorsement (CG2417) with a limit of liability not less than \$3,000,000 per occurrence and \$6,000,000 aggregate. Provide railroad flagman when employees and/or equipment are within 25 ft of the centerline of the railroad tracks OR AS DIRECTED BY RAILROAD.
 5. Automobile Liability insurance, covering all owned, non-owned, hired and leased vehicles with a minimum combined single limit for Bodily Injury and Property Damage of \$1,000,000 per accident. Insurance must include Contractual Liability.
 6. Umbrella/Excess Insurance – At Contractor's option, the limits specified in may be satisfied with a combination of primary and Umbrella/Excess Insurance.
 7. Additional Insured – The Contractor will include the City of Stuart as additional insured all policies except Workers' Compensation as respects all work performed for the jurisdiction.
 8. Insurance Certificates – Each policy noted above shall be issued by an insurance company authorized to write such insurance in the State of Iowa and shall be reasonably acceptable to City. These insurance policies shall not be canceled without at least 10 days prior written notice to City. A properly executed Certificate of Insurance showing evidence of these insurance requirements shall be delivered to City prior to the commencement of this lease.
 9. The company and the insured expressly agree and state that the purchase of this policy of insurance by the insured does not waive any of the defenses of governmental immunity available to the insured under Iowa Code Section 670.4 as it now exists and as it may be amended from time to time.

C. Subrogation:

1. To the extent that such insurance is in force and collectible and to the extent permitted by law, City and Contractor each hereby releases and waives all right of recovery against the other or anyone claiming through or under each of them by way of subrogation or otherwise. The foregoing release and waiver shall apply to damage to contractor's equipment, tools, and other personal property as well as automobiles.

END OF SECTION

**SECTION 01 351
SPECIAL PROCEDURES FOR HISTORIC TREATMENT**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general protection and treatment procedures for entire Project.

1.2 DEFINITIONS

- A. Consolidate: To strengthen loose or deteriorated materials in place.
- B. Dismantle: To disassemble and detach items by hand from existing construction to the limits indicated, using small hand tools and small one-hand power tools, so as to protect nearby historic surfaces; and legally dispose of dismantled items off-site, unless indicated to be salvaged or reinstalled.
- C. Existing to Remain: Existing items that are not to be removed or dismantled.
- D. Historic: Spaces, areas, rooms, surfaces, materials, finishes, and overall appearance which are important to the successful rehabilitation as required by the Secretary of the Interior's Standards for Rehabilitation and as determined by Architect.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
- F. Reconstruct: To remove existing item, replicate damaged or missing components, and reinstall in original position.
- G. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
- H. Reinstall: To protect removed or dismantled item, repair and clean it as indicated for reuse, and reinstall it in original position, or where indicated.
- I. Remove: Specifically for historic spaces, areas, rooms, and surfaces, the term means to detach an item from existing construction to the limits indicated, using hand tools and hand-operated power equipment, and legally dispose of it off-site, unless indicated to be salvaged or reinstalled.
- J. Repair: To correct damage and defects, retaining existing materials, features, and finishes while employing as little new material as possible. Includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- K. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- L. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- M. Reproduce: To fabricate a new item, accurate in detail to the original, and in either the same or a similar material as the original, unless otherwise indicated.
- N. Restore: To consolidate, replicate, reproduce, repair, and refinish as required to achieve the indicated results.
- O. Retain: To keep existing items that are not to be removed or dismantled.
- P. Reversible: New construction work, treatments, or processes that can be removed or undone in the future without damaging historic materials unless otherwise indicated.
- Q. Salvage: To protect removed or dismantled items and deliver them to Owner.
- R. Stabilize: To provide structural reinforcement of unsafe or deteriorated items while maintaining the essential form as it exists at present; also, to reestablish a weather-resistant enclosure.
- S. Strip: To remove existing finish down to base material unless otherwise indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by Contractor's operations.

1.4 QUALITY ASSURANCE

- A. Perform all work in compliance with the Secretary of the Interior's Standards for Rehabilitation.
- B. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-prevention devices during each phase or process. Include each fire watch's training, duties, and authority to enforce fire safety. Inform all subcontractors of and about the fire prevention plan.

- C. Regulatory Requirements: Comply with notification regulations of authorities having jurisdiction before beginning removal and dismantling work. Comply with hauling and disposal regulations of authorities having jurisdiction.
 - D. Standards: Comply with ANSI/ASSE A10.6.
- 1.5 STORAGE AND PROTECTION OF HISTORIC MATERIALS
- A. Salvaged Historic Materials:
 1. Clean only loose debris from salvaged historic items unless more extensive cleaning is indicated.
 2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area on-site designated by Owner.
 5. Protect items from damage during transport and storage.
 - B. Historic Materials for Reinstallation:
 1. Repair and clean historic items as indicated and to functional condition for reuse.
 2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make item functional for use indicated.
 - C. Existing Historic Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after historic treatment and construction work in the vicinity is complete.
 - D. Storage and Protection: When taken from their existing locations, catalog and store historic items within a weathertight enclosure where they are protected from wetting by rain, snow, condensation, or ground water, and from freezing temperatures.
 1. Identify each item with a nonpermanent mark to document its original location. Indicate original locations on plans elevations, sections, or photographs by annotating the identifying marks.
 2. Secure stored materials to protect from theft.
- 1.6 PROJECT CONDITIONS
- A. Owner will occupy portions of building immediately adjacent to removal and dismantling area. Conduct removal and dismantling work so Owner's operations will not be disrupted.
 - B. Hazardous Materials: With the exception paints and coatings containing lead it is not expected that hazardous materials will be encountered in the Work.
 1. If materials suspected of containing hazardous materials other than lead are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract that are not otherwise identified for abatement.
 2. The Contractor is responsible for proper abatement and disposal of all lead based products according to authorities having jurisdiction. The Architect is not involved in the specifications related to handling of any toxic materials on the site and assumes no liability with such work.
 - C. Storage or sale of removed or dismantled items on-site is not permitted unless otherwise indicated.
- PART 2 - PRODUCTS - (Not Used)
- PART 3 - EXECUTION
- 3.1 EXAMINATION
- A. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
- 3.2 PROTECTION, GENERAL
- A. Ensure that supervisory personnel are on-site and on duty when historic treatment work begins and during its progress.
 - B. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from historic treatment procedures.

1. Use only proven protection methods, appropriate to each area and surface being protected.
 2. Provide barricades, barriers, and temporary directional signage to exclude public from areas where historic treatment work is being performed.
 3. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of historic treatment work.
- C. Temporary Protection of Historic Materials:
1. Protect existing historic materials with temporary protections and construction. Do not deface or remove existing materials.
 2. Do not attach temporary protection to historic surfaces except as indicated as part of the historic treatment program and approved by Architect.
- D. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- 3.3 PROTECTION FROM FIRE
- A. General: Follow fire-prevention plan and the following.
1. Comply with NFPA 241 requirements unless otherwise indicated. Perform duties entitled "Owner's Responsibility for Fire Protection."
 2. Remove and keep area free of combustibles including, rubbish, paper, waste, and chemicals, except to the degree necessary for the immediate work.
 - a. If combustible material cannot be removed, provide fire blankets to cover such materials.
 3. Prohibit smoking by all persons within Project site.
- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or highly combustible materials, including welding, torch-cutting, soldering, brazing, paint removal with heat, or other operations where open flames or implements utilizing high heat or combustible solvents and chemicals are anticipated:
1. Use of open-flame equipment is not permitted.
 2. As far as practical, restrict heat-generating equipment to shop areas or outside the building.
 3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
 4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
 5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
 6. Fire Watch: Before working with heat-generating equipment or highly combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows.
 - a. Train each fire watch in the proper operation of fire-control equipment and alarms.
 - b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
 - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
 - d. Have fire watch perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work at Project site to detect hidden or smoldering fires and to ensure that proper fire-prevention is maintained.
 - e. Maintain fire-watch personnel at Project site until 60 minutes after conclusion of daily work.
- C. Fire Extinguishers, Fire Blankets, and Rag Buckets: Maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the

type of fire risk in each work area. Ensure that nearby personnel and the fire watch are trained in fire-extinguisher and blanket operation.

3.4 GENERAL HISTORIC TREATMENT

- A. Ensure that supervisory personnel are present when historic treatment work begins and during its progress.
- B. Halt the process of deterioration and stabilize conditions, unless otherwise indicated. Perform work as indicated on Drawings. Follow the procedures in subparagraphs below and procedures approved in historic treatment program:
 - 1. Retain as much existing material as possible; repair and consolidate rather than replace.
 - 2. Use additional material or structure to reinforce, strengthen, prop, tie, and support existing material or structure.
 - 3. Use reversible processes wherever possible.
 - 4. Use historically accurate repair and replacement materials and techniques unless otherwise indicated.
 - 5. Record existing work before each procedure (preconstruction) and progress during the work with digital preconstruction documentation.
- C. Notify Architect of visible changes in the integrity of material or components whether due to environmental causes including biological attack, UV degradation, freezing, or thawing; or due to structural defects including cracks, movement, or distortion.
 - 1. Do not proceed with the work in question until directed by Architect.
- D. Where missing features are indicated to be repaired or replaced, provide features whose designs are based on accurate duplications rather than on conjectural designs, subject to approval of Architect.
- E. Where Work requires existing features to be removed or dismantled and reinstalled, perform these operations without damage to the material itself, to adjacent materials, or to the substrate.
- F. Identify new and replacement materials and features with permanent marks hidden in the completed work to distinguish them from original materials. Record a legend of identification marks and the locations of the items on record Drawings.

3.5 HISTORIC REMOVAL AND DISMANTLING

- A. General: Have removal and dismantling work performed by a qualified historic treatment specialist.
- B. Perform work in compliance with the Secretary of the Interior's Standards for Rehabilitation.
- C. Anchorages:
 - 1. Remove anchorages associated with removed items.
 - 2. Dismantle anchorages associated with dismantled items.
 - 3. In non-historic surfaces, patch holes created by anchorage removal or dismantling according to the requirements for new work.
 - 4. In historic surfaces, patch or repair holes created by anchorage removal or dismantling according to Section specific to the historic surface being patched.

END OF SECTION

**SECTION 01 420
REFERENCES**

PART 1 - GENERAL

1.1 DEFINITIONS

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

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

**SECTION 01 500
TEMPORARY FACILITIES AND CONTROLS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Section:
 - 1. Division 01 Section "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

2.4 RAILROAD WORKPLACE SAFETY

- A. Comply with the Code of Federal Regulations regarding Railroad Workplace Safety including but not limited to:
 - 1. Safety training.
 - 2. Train approach warning (watchmen and/or flaggers).
 - 3. All required notifications and documentation.
- B. Contact

Iowa Interstate Railroad, LTD
5900 6th Street S.W.
Cedar Rapids, Iowa 52404
Phone 319-298-5400

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

3.9 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- B. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- C. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- D. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

3.10 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

END OF SECTION

**SECTION 01 524
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition waste.
 - 2. Disposing of nonhazardous demolition and construction waste.
- B. See individual Sections for additional disposal requirements.

1.2 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.
- B. Salvaged Items for Owner's Use:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area on-site designated by Owner.
 - 5. Protect items from damage during transport and storage.

3.2 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION

**SECTION 01 600
PRODUCT REQUIREMENTS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Show compliance with requirements by submitting comparative product information and statement that proposed substitution is equivalent in all ways to the basis of design and requires no modifications to the project to facilitate its proper use.

1.4 QUALITY ASSURANCE

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

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Refer to other Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

3. Products:
 - a. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
 4. Manufacturers:
 - a. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
 5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
- 2.2 COMPARABLE PRODUCTS
- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION

**SECTION 01 700
EXECUTION REQUIREMENTS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
 - 9. Correction of the Work.
- B. Related Requirements:
 - 1. Section 01100 "Summary" for limits on use of Project site.

1.2 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.

2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.
- 3.2 PREPARATION
- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a written request for information to Architect describing all pertinent information associated with the request.
- 3.3 CONSTRUCTION LAYOUT
- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- 3.4 INSTALLATION
- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
 - J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.
- 3.5 CUTTING AND PATCHING
- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
 - B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
 - C. Temporary Support: Provide temporary support of work to be cut.
 - D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
 - E. Adjacent Occupied Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
 - F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
 - G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 5. Proceed with patching after construction operations requiring cutting are complete.
 - H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall

coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION

**SECTION 01 739
CUTTING AND PATCHING**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. See Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.2 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION

**SECTION 01 781
PROJECT RECORD DOCUMENTS**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
- B. See Divisions 02 through 16 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.2 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit two set(s) of marked-up Record Prints.
- B. Record Specifications: Submit two sets of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit two copies of each Product Data submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
 - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - 2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 3. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - 4. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION

**SECTION 03 300
CAST-IN-PLACE CONCRETE**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes. Types of work include:
 - 1. Interior slabs.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture.
- C. Material certificates.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5 and as modified in this section.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed
- B. Dowels: smooth, galvanized bars of size indicated on drawings.

2.2 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I.
- B. Normal-Weight Aggregates: ASTM C 33.
- C. Water: ASTM C 94/C 94M and potable.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.; approved products:
 - a. "Eucon Super WR-75", Euclid Chemical Company.
 - b. "Pozzolith Normal", Master Builders.
 - c. "Plastocrete 161", Sika Chemical Corporation.
 - 2. Retarding Admixture and Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type B and D respectively; approved products:
 - a. "Eucon Retarder-75" Euclid Chemical Company.
 - b. "Pozzolith retarder", Master Builders.
 - c. "Plastocrete 161 R", Sika Chemical Corporation.

2.3 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

- E. Liquid floor hardener (at all exposed to view, interior, concrete floors): colorless fluorosilicate base solution diluted and applied according to the manufacturer's recommendations at the rate of 200 square feet of slab area per gallon of solution.
- 2.4 RELATED MATERIALS
- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
 - B. Epoxy joint filler: three compound, 100% solids, compound, with a minimum shore D hardness of 50.
- 2.5 CONCRETE MIXTURES
- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 as modified in this section.
 1. Refer to Concrete Schedule at end of this section.
- 2.6 FABRICATING REINFORCEMENT
- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."
- 2.7 CONCRETE MIXING
- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- PART 3 - EXECUTION
- 3.1 FORMWORK
- A. Design, erect, shore, brace, and maintain formwork according to ACI 301 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
 - B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- 3.2 EMBEDDED ITEMS
- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- 3.3 STEEL REINFORCEMENT
- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- 3.4 JOINTS
- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
 - B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-third of concrete thickness as follows:
 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
- 3.5 CONCRETE PLACEMENT
- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
 - B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

- 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 301.
- E. Tolerances
 - 1. ACI 301 4.3
- 3.6 FINISHING FLOORS AND SLABS
 - A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
 - B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces exposed to view or to be covered with wood flooring, paint, or another thin-film-finish coating system.
 - 2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot- long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/4 inch. ACI 301 11.7.3 Class B tolerance.
- 3.7 CONCRETE PROTECTING AND CURING
 - A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
 - B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
 - C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 - 2. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.
- 3.8 CONCRETE SURFACE REPAIRS
 - A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- 3.9 FIELD QUALITY CONTROL
 - A. Testing and Inspecting: Owner may engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
 - 1. Testing Services: Tests shall be performed according to ACI 301.
- 3.10 CONCRETE SCHEDULE

Type of Construction	Compressive Strength @ 28 days	Slump Inches (before plasticizer added)	Maximum Aggregate	Air Content % by Volume	Maximum Water-Cement
Interior Slabs on Grade	4000 psi	4 inches ±1 inch	1 inch	1% to 3%	0.48

END OF SECTION

**SECTION 04 810
UNIT MASONRY****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes maintenance of unit masonry consisting of brick clay masonry restoration as follows:
1. Rebuilding masonry chimneys above roofline. The chimney is decorative only and does not have a flue or liner. It is constructed on top of existing bricks projecting above the roof to the specified height.

1.2 SUBMITTALS

- A. Samples: For each exposed product and for each color and texture specified.
1. For all replacement brick provided by contractor.

1.3 QUALITY ASSURANCE

- A. Restoration Specialist Qualifications: Engage an experienced masonry restoration firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience installing standard unit masonry is not sufficient experience for masonry restoration work.
1. Field Supervision: Restoration specialist firms shall maintain experienced full-time supervisors on Project site during times that clay masonry restoration work is in progress.
- B. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS**2.1 MASONRY MATERIALS**

- A. Face Brick: Provide face brick, cut, or sawed shapes where required to complete masonry restoration work.
1. Provide units with physical properties, colors, color variation within units, surface texture, size, and shape to match existing historic brickwork.

2.2 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II, white.
1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Mortar Sand: ASTM C 144 unless otherwise indicated.
1. Color: Provide natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
 2. For pointing mortar, provide sand with rounded edges.
 3. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
- D. Mortar Pigments: Natural and synthetic iron oxides, compounded for mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortars.
- E. Water: Potable.

2.3 CLEANING MATERIALS

- A. Water: Potable.

2.4 MORTAR MIXES

- A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.
1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

- B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.
 - 1. Mortar Pigments: Where mortar pigments are indicated, do not exceed a pigment-to-cement ratio of 1:10 by weight.
- C. Do not use admixtures in mortar unless otherwise indicated.
- D. Mortar Proportions: Mix mortar materials in the following proportions as a first trial mix, vary ingredients in subsequent trials as necessary to achieve match to historic mortar, repeat trial mixes until acceptable match as determined by architect is achieved:
 - 1. For exterior, above-grade, use Type N.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect existing roof from damage.
- B. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from masonry restoration work.
- C. Keep wall wet below area being cleaned to prevent streaking from runoff.

3.2 TOLERANCES

- A. Lines and Levels: For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet maximum.
- B. Joints:
 - 1. Match joints on body of building.
 - 2. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.
 - 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
 - 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.3 LAYING MASONRY

- A. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond to match masonry extant on building; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- B. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.
- C. Clean bricks surrounding removal areas by removing mortar, dust, and loose particles in preparation for replacement. Notify architect if adequate bond to support and connect new work to existing construction will not be achieved.
- D. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.
 - 1. Maintain joint width for replacement units to match existing joints.
- E. Lay brick with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min.. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.
 - 1. Tool exposed mortar joints in repaired areas to match joints of existing brickwork.
 - 2. Rake out mortar used for laying brick before mortar sets and point new mortar joints in repaired area to comply with requirements for repointing existing masonry, and at same time as repointing of surrounding area.

3.4 FINAL CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, spray applied at low pressure.
 - 1. Do not use metal scrapers or brushes.
 - 2. Do not use acidic or alkaline cleaners.

END OF SECTION

**SECTION 05 500
METAL FABRICATIONS**

PART 1 - GENERAL**1.1 SECTION INCLUDES**

- A. Metal fabrications and repairs.
 - 1. Remove salvage, repair and reinstall iron grilles.
 - 2. Using extant window grilles as pattern fabricate replacement to match extant and install where indicated.

1.2 SUBMITTALS

- A. Submit shop drawings indicating locations, markings, quantities, materials, sizes and shapes. Indicate methods of connecting, anchoring, fastening, bracing, and attaching to work of other trades.

PART 2 - PRODUCTS**2.1 BASIC MATERIALS**

- A. Ferrous metals:
 - 1. Steel shapes and plates: ASTM A36 or ASTM A572, grade 50.
- B. Shop primer for ferrous metal: fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
- C. Fasteners:
 - 1. Lag bolts: ASME B18.2.1; ASME B18.2.3.8M.
 - 2. Wood screws: flat head, carbon steel, ASME B18.6.1.
 - 3. Plain washers: round, carbon steel, ASME B18.22.1; ASME B18.22M.
- D. Welding: AWS D1.1. miter and cope intersections and weld all around. Remove splatter, grind exposed welds to blend and contour surfaces to match those adjacent.

2.2 METAL FABRICATIONS

- A. Miscellaneous framing and supports:
 - 1. Provide steel framing and supports that are not a part of structural steel framework as necessary to complete the Work.
 - 2. Fabricate units from structural steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

2.3 FINISH

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces in direct contact bond with concrete or where field welding is required.
- C. Prime paint items scheduled with one coat unless indicated otherwise.

2.4 FABRICATION

- A. Verify dimensions on site prior to shop fabrication.
- B. Where possible, prefabricate items off-site complete and ready for installation.
- C. Fabricate items with joints tightly fitted and secured.
- D. Fit and shop assemble in largest practical sections, for delivery to site.
- E. Grind exposed welds flush and smooth with adjacent finished surface. Ease exposed edges to small uniform radius.
- F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of structure, except where specifically noted otherwise.
- G. Make exposed joints butt tight, flush, and hairline.
- H. Supply components required for anchorage of metal fabrications. Fabricate anchorage and related components of same material and finish as metal fabrication, except where specifically noted otherwise.
- I. Welding:

1. Weld shop connections.
2. Make joints and intersections of metal tightly fitting and securely fastened.
3. Make work square, plumb, straight and true.

J. Thoroughly clean metal of mill scale, rust and foreign matter prior to shop painting.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Make field measurements to ensure proper and adequate fit of metal fabrications and to verify that metal fabrications may be fabricated and installed in strict accordance with original design.

3.2 INSTALLATION, GENERAL

- A. Fastening to in-place construction: provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.
- B. Cutting, fitting, and placement: perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

3.3 ADJUSTING AND CLEANING

A. Touchup painting: immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

END OF SECTION

**SECTION 06100
ROUGH CARPENTRY**

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES

1. Framing with dimension lumber.
2. Wood blocking, cants, and nailers.
3. Wood furring and grounds.
4. Wood sleepers.
5. Plywood backing panels.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: Provide dressed lumber, S4S, marked with grade stamp of inspection agency.
- B. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

2.2 TREATED MATERIALS

- A. Preservative-Treated Materials: AWWA C2, except that lumber not in ground contact and not exposed to the weather may be treated according to AWWA C31 with inorganic boron (SBX).
 1. Use treatment containing no arsenic or chromium.
 2. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
 3. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- B. Provide preservative-treated materials for items indicated on Drawings, and the following:
 1. Concealed members in contact with masonry or concrete.
 2. Wood framing members that are less than 18 inches above the ground.
 3. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 LUMBER

A. Dimension Lumber:

1. Maximum Moisture Content: 19 percent.
2. Non-Load-Bearing Interior Partitions: Construction or No. 2: Any species.
3. Framing Other Than Non-Load-Bearing Interior Partitions: No. 2: Hem-fir (north): NLGA; Southern pine: SPIB Douglas fir-larch: WCLIB, or WWPA; Spruce-pine-fir: NLGA; Douglas fir south: WWPA; Hem-fir: WCLIB, or WWPA; Douglas fir-larch (north): NLGA; or Spruce-pine-fir (south): NeLMA, WCLIB, or WWPA.
4. Exposed Framing: Provide material hand-selected for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.
 - a. Species: As specified for framing other than non-load-bearing interior partitions.
 - b. Grade: Select Structural No. 2.

B. Exposed Boards: Eastern white, Idaho white, lodgepole, ponderosa, or sugar pine, Premium or 2 Common (Sterling): NeLMA, NLGA, WCLIB, or WWPA; Hem-fir, Select Merchantable or No. 1 Common: NLGA, WCLIB, or WWPA; with 19 percent maximum moisture content.

C. Concealed Boards: Eastern softwoods, No. 3 Common: NELMA; Northern species, No. 3 Common: NLGA; with 19 percent maximum moisture content.

D. Miscellaneous Lumber: Construction, or No. 2 grade with 19 percent maximum moisture content of any species. Provide for nailers, blocking, and similar members.

2.4 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: Plywood, Exposure 1, C-D Plugged, fire-retardant treated, not less than 3/4-inch nominal thickness.

2.5 MISCELLANEOUS PRODUCTS

- A. Fasteners: Size and type indicated. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

1. Power-Driven Fasteners: CABO NER-272.
 2. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- B. Metal Framing Anchors: Structural capacity, type, and size indicated.
1. Use anchors made from hot-dip galvanized steel complying with ASTM A 653/A 653M, G60 coating designation for interior locations where stainless steel is not indicated.
 2. Use anchors made from stainless steel complying with ASTM A 666, Type 304 for exterior locations and where indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Securely attach rough carpentry to substrates, complying with the following:
1. CABO NER-272 for power-driven fasteners.
 2. Published requirements of metal framing anchor manufacturer.
 3. Table 2304.9.1, "Fastening Schedule," in the IBC.

END OF SECTION

**SECTION 06160
SHEATHING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes
 - 1. Subflooring.

PART 2 - PRODUCTS**2.1 WOOD PANEL PRODUCTS, GENERAL**

- A. Plywood: DOC PS 1.

2.2 SUBFLOORING

- A. Subflooring:
 - 1. Plywood Subflooring: Exterior, Structural I single-floor panels or sheathing. Thickness to be 3/4".

2.3 MISCELLANEOUS PRODUCTS

- A. Vapor Retarder 6 mil polyethylene film.
- B. Fasteners: Size and type indicated.
 - 1. Power-Driven Fasteners: CABO NER-272.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Vapor Retarder: Cover the entire slab with polyethylene film, overlapping the edges 6 inch minimum, and allowing enough film to extend up under the baseboard on all sides of the room for at least three inches vertically.
- B. Install plywood subfloor after the vapor retarder leaving 3/4 inch space at the wall line and 1/4 inch to 1/2 inch between panels. Cut plywood to fit within 1/8 inch near door jambs and other obstructions where finish trim will not be used. Lay plywood diagonally across the direction of the finished floor.
- C. Securely attach to substrates, complying with the following:
 - 1. CABO NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in the IBC.
- D. Fastening Methods:
 - 1. Subflooring:
 - a. Power actuated fastener to concrete slab. Fasten the center of the panel first, then the edges spacing fasteners 2 inches from the edges every 6-8 inches along the perimeter and 1 fastener spaced approximately 12 inches apart within the interior of the panel.

END OF SECTION

**SECTION 06 201
EXTERIOR FINISH CARPENTRY**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Exterior standing and running trim.
 - a. Lumber trim except at frieze and fascia where composite trim shall be used.
 - 2. Replacement of frieze board at junction of soffit and masonry on all facades.
 - 3. Beaded Board soffits.
 - 4. Repair and installation of historic wood brackets at roof edges.
 - a. Brackets are currently stored inside depot.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable grading rules of inspection agencies certified by ALSC's Board of Review.
- B. Softwood Plywood: DOC PS 1.

2.2 STANDING AND RUNNING TRIM

- A. Lumber Trim:
 - 1. Species and Grade: Eastern white pine, eastern hemlock-balsam fir-tamarack, eastern spruce, or white woods; D Select (Quality); NeLMA, NLGA, WCLIB, or WWPA.
 - 2. Maximum Moisture Content: 19 percent.
 - 3. Face Surface: Surfaced (smooth).
- B. Composite Trim:
 - 1. Fascia/Frieze: Size boards to match existing similar elements in thickness and width.
 - 2. Use maximum lengths possible.
 - 3. Secure with stainless steel fasteners per manufacturer's instructions.
 - 4. Basis of Design is "Trex", other products of similar composition and physical characteristics may be substituted with architect's approval including but not limited to Hardi Boards and Tru Wood.

2.3 BOARD SOFFITS (Beaded Wood)

- A. Beaded tongue and groove. WWPA pattern 1x6 E & CB Ceiling (S2S & CM E & CB1S).
- B. Doug fir vertical grain, 1inch x 6 inch x 3/4 inch

2.4 ROOF BRACKETS

- A. Repair existing brackets currently stored inside depot. Replace deteriorated wood that cannot be stabilized with wood consolidant or wood-patching compound using clear, straight slumber of species matching historic wood and fit and blended to match profiles of wood in area replaced.

2.5 WOOD REPAIR MATERIALS

- A. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated due to weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Abatron, Inc.; LiquidWood.
 - b. ConServ Epoxy LLC; Flexible Epoxy Consolidant 100.
 - c. Wood Care Systems; ROTFIX.
- B. Wood-Patching Compound: Two-part epoxy-resin wood-patching compound; knife-grade formulation as recommended by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound shall be capable of filling deep holes and spreading to feather edge.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Abatron, Inc.; LiquidWood with WoodEpoxy.
 - b. ConServ Epoxy LLC; Flexible Epoxy Consolidant 100 with Flexible Epoxy Patch 200.

- c. Wood Care Systems; ROTFIX with SCULPWOOD.
- 2.6 MISCELLANEOUS MATERIALS
- A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.
 - 1. For prefinished items, provide matching prefinished aluminum fasteners where face fastening is required.
 - 2. For applications not otherwise indicated, provide stainless-steel fasteners.
 - B. Sealants: Latex, complying with ASTM C 834, Type P, Grade NF and with applicable requirements in Division 07 Section "Joint Sealants," recommended by sealant manufacturer and manufacturer of substrates for intended application.
- PART 3 - EXECUTION
- 3.1 PREPARATION
- A. Prime lumber to be painted, including both faces and edges. Cut to required lengths and prime ends. Comply with requirements in Division 09 Section "Exterior Painting."
- 3.2 INSTALLATION, GENERAL
- A. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
 - 1. Scribe and cut exterior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 2. Install stairs with no more than 3/16-inch variation between adjacent treads and risers and with no more than 3/8-inch variation between largest and smallest treads and risers within each flight.
- 3.3 STANDING AND RUNNING TRIM INSTALLATION
- A. Install flat grain lumber with bark side exposed to weather.
 - B. Install composite trim to comply with manufacturer's written instructions.
 - C. Install trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long except where necessary.
 - 1. Use scarf joints for end-to-end joints.
 - 2. Stagger end joints in adjacent and related members.
 - D. Fit exterior joints to exclude water. Cope at returns and miter at corners.

END OF SECTION

**SECTION 06402
INTERIOR ARCHITECTURAL WOODWORK**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes interior woodwork including for the following applications:
 - 1 Standing and running trim.
 - a. Salvaged, stripped and reinstalled
 - b. New fabricated to match existing
 - 2 Wainscoting
 - a. Salvaged, stripped and reinstalled.
 - b. New
 - 3 Cabinets and Hardware
 - 4 Countertops
 - 5 Frames and jambs.
 - 6 Custom fabricated casework and trim.
- B. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips, unless concealed within other construction before woodwork installation.

1.2 SUBMITTALS

- A. Shop Drawings: Include location of each item, plans and elevations, large-scale details, attachment devices, and other components.
- B. Samples:
 - 1 Lumber and panel products for transparent finish, for each species and cut, finished on one side and one edge.
 - 2 Lumber and panel products with shop-applied opaque finish, for each finish system and color, with exposed surface finished.

1.3 QUALITY ASSURANCE

- A. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork, construction, finishes, and other requirements.
 - 1 Premium grade.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 Manufacturers

- A. Basis-of-Design Product: Product named for each item indicated establishes the basis of design. Provide either the named product or a comparable product.

2.2 MATERIALS

- A. Wood and Veneer Wood for Transparent Finish:
 - 1 Species and Cut: Red oak, plain sawn or sliced.
- B. Wood for Opaque Finish:
 - 1 Species: Any closed-grain hardwood.
- C. Wood Products:
 - 1 Hardboard: AHA A135.4.
 - 2 Medium-Density Fiberboard: ANSI A208.2, Grade MD-Exterior Glue.
 - 3 Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 - 4 Softwood Plywood: DOC PS 1, Medium Density Overlay.
 - 5 Hardwood Plywood and Face Veneers: HPVA HP-1.
- D. Solid Surfacing Material
 - 1 Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ANSI Z124.3, for Type 5 or Type 6 material and performance requirements, without a precoated finish.
 - 2 Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1) Avonite, Inc.; Avonite. 2) DuPont Polymers; Corian. 3) Formica Corporation; Surell. 4) International Paper, Decorative Products Div.; Fountainhead. 5) Swan Corporation (The); Swanstone. 6) Wilsonart International, Div. of Premark International, Inc.; Gibraltar.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural woodwork, except for items specified in Division 08 Section "Door Hardware."
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening.
- C. Back-Mounted Pulls: BHMA A156.9, B02011.
 - 1 Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.
- D. Catches: Push-in magnetic catches, BHMA A156.9, B03131 .
- E. Drawer Slides: BHMA A156.9, B05091.
 - 1 Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
- F. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1 Satin Stainless Steel: BHMA 630.

2.3 WAINSCOTING and STANDING AND RUNNING TRIM

- A. Salvage and reuse existing materials giving priority to full coverage installation in the following sequence: Room 108, 111, and 112. Use all salvaged material until exhausted even if only partial coverage of a wall may be achieved. Complete installation using specified new material.
 - 1 Salvaged materials shall be stripped of all finishes and cleaned of all fasteners prior to reinstallation.
- B. Wainscoting: Where supplies of available salvaged materials are not sufficient to cover areas and in all other rooms besides those mentioned in 2.3 A. use beaded tongue and groove WWPA WP-10 of width to match existing (approx 6 inches - verify). Fabricate from paint grade wood.
- C. Standing and Running Trim: Where supplies of available salvaged materials are not sufficient to cover areas and in all other rooms besides those mentioned in 2.3 A. fabricate new material to match existing. Fabricate from paint grade wood.

2.4 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

2.5 FABRICATION

- A. General: Complete fabrication to maximum extent possible before shipment to Project site. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
 - 1 Interior Woodwork Grade: Premium complying with the referenced quality standard.
 - 2 Shop cut openings to maximum extent possible. Sand edges of cutouts to remove splinters and burrs.
 - 3 Install glass to comply with applicable requirements in Division 8 Section "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.
 - 4 For trim items wider than available lumber, use veneered construction. Do not glue for width.
 - 5 Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
 - 6 Assemble casings in plant except where limitations of access to place of installation require field assembly.
 - 7 Where new material is fabricated to supplement limited supplies of existing material the new shall be manufactured to match profiles of existing historic materials in the following spaces:
 - a. Base: Lobby 301, Alcove 304, Vest 306, Auditorium 309.
 - b. Casings and Misc Trim: match historic in all spaces.
- B. Cabinets for Transparent Finish:
 - 1. Fabricate to AWI Premium Quality Standards.
 - 2. Composite Panel with ¾ inch hardwood edge banding and face frame.
 - 3. Reveal Overlay (Frame) Construction AWI 400-05

4. Grain Direction: Vertically for drawer fronts, doors, and fixed panels .
 5. Matching of Veneer Leaves: Book match.
 6. Veneer Matching within Panel Face: Running match.
 7. Semiexposed Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surfaces .
 8. Drawer Sides and Backs: Solid-hardwood lumber, stained to match species indicated for exposed surfaces .
 9. Drawer Bottoms: Hardwood plywood.
 10. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.
 11. Shelf standards to be metal, recessed flush.
- C. Solid Surface Work Surfaces
- 1 Solid-Surfacing-Material Thickness: 3/4 inch.
 - 2 Colors, Patterns, and Finishes: As selected from manufacturer's full range.
 - 3 Fabricate tops in one piece with shop-applied edges, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

2.6 SHOP FINISHING

- A. Finish architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling.
- 1 Completely seal all six surfaces of each piece of composite panel after fabrication and prior to assembly of cabinets.
- C. Transparent Finish:
1. Grade: Premium.
 2. AWI Finish System: Acrylic lacquer .
 3. Staining: Match approved sample for color.
 4. Wash Coat for Stained Finish: Apply a wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
 5. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas and examine and complete work as required, including removal of packing and backpriming before installation.
- B. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in this Section for type of woodwork involved.
- C. Install woodwork level, plumb, true, and straight to a tolerance of 1/8 inch in 96 inches. Shim as required with concealed shims.
- D. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base, if finished.
- G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.
- 1 Fasten wall cabinets through back, near top and bottom, at ends and not more than 16

inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

- H. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

END OF SECTION

**SECTION 07210
BUILDING INSULATION**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Glass-fiber blanket insulation.
 2. Loose-fill insulation.
 3. Spray polyurethane foam insulation.
 - a. Closed Cell: Exterior walls where noted in wall type.
 - b. Open Cell: Exterior walls where noted in wall type.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. CertainTeed Corporation.
 2. Guardian Building Products, Inc.
 3. Johns Manville.
 4. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- C. Vapor Retarder: 6 mil polyethylene sheet over all unfaced insulation on warm side of insulation.

2.2 LOOSE-FILL INSULATION

- A. Glass-Fiber Loose-Fill Insulation: ASTM C 764, Type I for pneumatic application; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
- B. Vapor Retarder: 6 mil polyethylene sheet on warm side of insulation.

2.3 SPRAY POLYURETHANE FOAM INSULATION

- A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Corporation.
 - b. Dow Chemical Company (The).
 - c. Gaco Western Inc.
 - d. Icynene Inc (Basis of Design)
 - e. NCFI
 2. Minimum density of 1.5 lb/cu. ft., thermal resistivity of minimum 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F aged to achieve R value listed on drawings.
- B. Open-Cell Polyurethane Foam Insulation: Spray-applied polyurethane foam using water as a blowing agent, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Demilec (USA) LLC.
 - b. Gaco Western Inc.
 - c. Icynene Inc.
 2. Minimum density of 0.4 lb/cu. ft., thermal resistivity of 4.2 deg F x h x sq. ft./Btu x in. at 75 deg F aged to achieve R value listed on drawings..

PART 3 - EXECUTION**3.1 INSTALLATION, GENERAL**

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

3.2 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For wood-framed construction, install blankets according to ASTM C 1320.n last subparagraph above or first subparagraph below.
- C. Loose-Fill Insulation: Apply according to ASTM C 1015 and manufacturer's written instructions. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.
- D. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.
- E. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
 - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

END OF SECTION

**SECTION 07 215
UNDER SLAB THERMAL INSULATION**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Perimeter insulation under slabs-on-grade.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.60 lb/cu. ft.,
 - 1. Thermal Resistance of R=5.0 per inch thickness minimum.
 - 2. Compressive Strength minimum 25 psi (ASTM D1621)
 - 3. Water Absorption 0.3% by volume (ASTM C272)
 - 4. Fire Characteristics (E84/UL 723) flame spread 10, smoke developed 250 or less
 - 5. Available Manufacturers:
 - a. Dow Chemical Company.
 - b. Owens Corning.
 - c. Tenneco.
 - d. U.C. Industries.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to moisture, ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation.
- E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

- A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

END OF SECTION

SECTION 07 3113
ASPHALT SHINGLES and FLASHINGS

PART 1 - GENERAL**1.1 SUMMARY**

- A. Section Includes:
 - 1. Asphalt ridge shingles.
 - 2. Ridge vent.
 - 3. Provide roof flashing at rebuilt chimneys.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each exposed product and for each color and blend specified.

1.3 QUALITY ASSURANCE

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

1.4 SYSTEM DESCRIPTION

- A. Provide new attic ridge vent cut into existing roof system. System to include full coverage of ridge vent with shingles matching existing shingles in color and style installed in conformance with manufacturer's recommendations.

PART 2 - PRODUCTS**2.1 GLASS-FIBER-REINFORCED ASPHALT SHINGLES**

- A. Laminated-Strip Asphalt Shingles: ASTM D 3462, laminated, multi-ply overlay construction, glass-fiber reinforced, mineral-granule surfaced, and self-sealing.
 - 1. Strip Size: Manufacturer's standard.
 - 2. Algae Resistance: Granules treated to resist algae discoloration.
 - 3. Color and Blends: As selected by Architect from manufacturer's full range to match existing shingles.
- B. Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

2.2 SHINGLE OVER ROOF EDGE VENT

- A. Ventilation along drip edge of roof to be provided by roof edge vent system with internal weather filter, reinforced nail bosses, drainage system, integral drip edge, integrated end plug, internal baffles, reinforced ribs with limited lifetime warranty by Air Vent Inc or equal product.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Vent, Inc.; a Gibraltar Industries company.
 - b. Cor-A-Vent, Inc.
 - c. GAF Materials Corporation.
 - d. Lomanco, Inc.
 - e. Obdyke, Benjamin Incorporated.
 - f. Owens Corning.

2.3 ACCESSORIES

- A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.
- B. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch- diameter, smooth shank, sharp-pointed, with a minimum 3/8-inch- diameter flat head and of sufficient length to penetrate 3/4 inch into solid wood decking or extend at least 1/8 inch through OSB or plywood sheathing.
 - 1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.
- C. Chimney flashing: Formed metal base and counter flashing. Alloy coated stainless steel, satin finish manufactured of type 304 (non-magnetic) dead-soft stainless steel covered on both sides with ZT alloy to a thickness of 20 microns.

PART 3 - EXECUTION**3.1 ASPHALT SHINGLE INSTALLATION**

- A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

- B. Fasten asphalt shingle strips with roofing nails located according to manufacturer's written instructions.
 - 1. When ambient temperature during installation is below 50 deg F, seal asphalt shingles with asphalt roofing cement spots.

3.2 RIDGE VENTS and SHINGLES

- A. Install continuous ridge vents over asphalt shingles according to manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.
- B. Ridge and Hip Cap Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing.
 - 1. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

3.3 REGLET AND COUNTERFLASHING INSTALLATION

- A. Fabricate and install sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.
- B. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Fit counterflashings tightly to base flashings.

END OF SECTION

**SECTION 07 710
ROOF SPECIALTIES**

PART 1 - GENERAL**1.1 SUMMARY**

- A. Section Includes:
 - 1. Metal chimney cap.
 - 2. Roof-edge drainage systems, aluminum, prefinished metal.

1.2 QUALITY ASSURANCE

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

PART 2 - PRODUCTS**2.1 EXPOSED METALS**

- A. Chimney cap: Formed metal fabricated of alloy coated stainless steel, satin finish manufactured of type 304 (non-magnetic) dead-soft stainless steel covered on both sides with ZT alloy to a thickness of 20 microns.
- B. Roof Edge Drainage Gutters and Downspouts: 0.032 inch thick aluminum, factory finished with 20 year warranty of materials and finish.
 - 1. Gutter: K style, 6 inch with concealed fastener system into fascia. Fasteners installed into roof membrane (shingles) are not acceptable.
 - 2. Downspout Surface: Corrugated rectangular.

2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements.
- C. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- D. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Gutters: Manufactured in seamless lengths to minimize joints, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
 - 1. Gutter Profile: Style K according to SMACNA's "Architectural Sheet Metal Manual."
 - 2. Corners: Factory mitered and continuously welded.
 - 3. Gutter Supports: Gutter Screw and ferrules with finish matching the gutters.
 - 4. Gutter Accessories: Wire ball downspout strainer.
- G. Downspouts: Corrugated rectangular complete with machine-crimped elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
 - 1. 4 inch x 5 inch rectangular.

PART 3 - EXECUTION**3.1 INSTALLATION, GENERAL**

- A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.
 - 1. Provide uniform, neat seams with minimum exposure of solder and sealant.
 - 2. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of stainless-steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of self-adhering, high-temperature sheet underlayment.

3.2 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

- A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions.
- B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 24 inches apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.
 1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion joint caps.
- C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.

3.3 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Remove temporary protective coverings and strippable films as roof specialties are installed.

END OF SECTION

**SECTION 07 920
JOINT SEALANTS**

PART 1 - GENERAL**1.1 SUMMARY**

- A. Section Includes:
1. Silicone joint sealants.
 2. Urethane joint sealants.
 3. Latex joint sealants.
 4. Acoustical joint sealants.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS**2.1 MATERIALS, GENERAL**

- A. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

2.2 SILICONE JOINT SEALANTS

- A. Mildew-Resistant Neutral-Curing Silicone Joint Sealant SS-1: ASTM C 920.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems.
 - b. Dow Corning Corporation.
 - c. GE Advanced Materials - Silicones.
 - d. Pecora Corporation.
 - e. Sika Corporation; Construction Products Division.
 - f. Tremco Incorporated.
 2. Type: Single component (S) or multicomponent (M).
 3. Grade: nonsag (NS).
 4. Class: FDA Regulation 21 CFR 177.2600.
 5. Uses Related to Exposure: Nontraffic (NT).
- B. Mildew-Resistant Silicone Joint Sealant SS-2: ASTM C 920.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. BASF Building Systems.
 - b. Dow Corning Corporation.
 - c. GE Advanced Materials - Silicones.
 - d. Pecora Corporation.
 - e. Sika Corporation; Construction Products Division.
 - f. Tremco Incorporated.
2. Type: Single component (S) or multicomponent (M).
 3. Grade: nonsag (NS).
 4. Class: 25.
 5. Uses Related to Exposure: Nontraffic (NT).
- 2.3 URETHANE JOINT SEALANTS
- A. Urethane Joint Sealant US 1: ASTM C 920.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems.
 - b. Pecora Corporation.
 - c. Sika Corporation; Construction Products Division.
 - d. Tremco Incorporated.
 2. Type: Single component (S) Self Leveling.
 3. Grade: Pourable (P) .
 4. Class: 25.
 5. Uses Related to Exposure: Traffic (T).
- B. Urethane Joint Sealant US 2: ASTM C 920.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems.
 - b. Pecora Corporation.
 - c. Sika Corporation; Construction Products Division.
 - d. Tremco Incorporated.
 2. Type: Multicomponent (M).
 3. Grade: NonSag (NS) .
 4. Class: 25.
 5. Uses Related to Exposure: NonTraffic (NT).
- 2.4 LATEX JOINT SEALANTS
- A. Latex Joint Sealant LS-1: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems.
 - b. Pecora Corporation.
 - c. Sika Corporation; Construction Products Division.
 - d. Tremco Incorporated.
- 2.5 ACOUSTICAL JOINT SEALANTS
- A. Acoustical Joint Sealant AS-1: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems.
 - b. Pecora Corporation.
 - c. Sika Corporation; Construction Products Division.

d. Tremco Incorporated.

2.6 JOINT SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin)] Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
 1. Remove laitance and form-release agents from concrete.
 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
 - F. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.
 - G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- 3.3 JOINT-SEALANT SCHEDULE
- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces
 1. Designation: JS-1.
 2. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs and paving.
 - b. Other joints as indicated.
 3. Joint Sealant: US-1.
 4. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
 - B. Joint-Sealant Application: Typical exterior use unless otherwise noted.
 1. Designation: JS-2.
 2. Exterior joints in vertical surfaces and horizontal nontraffic surfaces .
 3. Joint Sealant: US-2.
 4. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
 - C. Joint-Sealant Application: Typical interior use unless otherwise noted.
 1. Designation: JS-3.
 2. Joint Sealant: LS-1.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
 - D. Joint-Sealant Application: For use in food preparation/serving areas.
 1. Designation: JS-4.
 2. Joint Sealant: SS-1.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
 - E. Joint-Sealant Application: For use around plumbing fixtures, sinks and similar wet areas.
 1. Designation: JS-5.
 2. Joint Sealant: SS-2.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
 - F. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces
 1. Designation: JS-6.
 2. Joint Location:
 - a. Acoustical joints where indicated.
 - b. Other joints as indicated.
 3. Joint Sealant: AS-1.
 4. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION

**SECTION 08 015
HISTORIC TREATMENT OF WOOD WINDOWS**

PART 1 - GENERAL**1.1 SUMMARY**

- A. Section Includes:
1. Wood window repair.
 2. Reglazing.
 3. Resetting salvaged glass.
 4. Setting new glass.
 5. Window hardware repair, refinishing, and replacement.
 6. Weatherstripping

1.2 DEFINITIONS

- A. General: See Division 01 Section "Historic Treatment Procedures" for other definitions.
- B. Design Reference Sample: A Sample that represents Architect's prebid selection of work to be matched; it may be existing work or specially produced for Project.
- C. Window: Includes window frame, sash, and storm window unless otherwise indicated by the context.

1.3 QUALITY ASSURANCE

- A. Historic Treatment Specialist Qualifications: A qualified historic wood window specialist.
- B. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for materials and execution and for fabrication and installation. Prepare mockups so they are inconspicuous or reversible.
1. Wood Window Repair: Prepare one entire window unit to serve as mockup to demonstrate sample repairs of wood window members including frame, sash, glazing, and hardware.
- C. AWI Quality Standard: Comply with applicable requirements in AWI's "Architectural Woodwork Quality Standards" for construction, finishes, grades of wood windows, and other requirements.
- D. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS**2.1 REPLACEMENT WOOD MATERIALS**

- A. Wood: Clear fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch deep by 2 inches wide.
1. Species: Match species of each existing primary sash.

2.2 WOOD REPAIR MATERIALS

- A. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated due to weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Abatron, Inc.; LiquidWood.
 - b. ConServ Epoxy LLC; Flexible Epoxy Consolidant 100.
 - c. Wood Care Systems; ROTFIX.
- B. Wood-Patching Compound: Two-part epoxy-resin wood-patching compound; knife-grade formulation as recommended by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound shall be capable of filling deep holes and spreading to feather edge.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Abatron, Inc.; LiquidWood with WoodEpoxy.
 - b. Advanced Repair Technology, Inc.; Primatrate with Flex-Tec HV.
 - c. ConServ Epoxy LLC; Flexible Epoxy Consolidant 100 with Flexible Epoxy Patch 200.
 - d. Polymeric Systems, Inc.; QuickWood.

- e. West System Inc.; West System.
- f. Wood Care Systems; ROTFIX with SCULPWOOD.

2.3 GLAZING MATERIALS

- A. Glass and Glazing Materials: See Division 08 Section "Glazing."

2.4 WINDOW HARDWARE

- A. General: Provide complete sets of window hardware consisting of sash balances, hinges, pulls, latches, and accessories indicated for each window or required for proper operation. Window hardware shall smoothly operate, tightly close, and securely lock wood windows and be sized to accommodate sash or ventilator weight and dimensions.
- B. Material and Design:
 - 1. Material: Existing.
 - 2. Design: existing hardware.
 - 3. Weight and Pulley Sash-Balance: Concealed weight and pulley balance system including steel or cast iron weights, cast-bronze pulleys, synthetic sash cord or sash chain; size and capacity to hold sash stationary at any open position.
- C. Window Hardware Finishes: Remove paint and restore original finish on all exposed operational hardware including, lift handles, latches and pulleys.

2.5 WEATHER STRIPPING

- A. Metal Weather Stripping: Bronze weather stripping; designed either as one piece to seal by sliding into a groove in the sash or as two pieces that interlock with each other; and completely concealed when wood window is closed.

2.6 MISCELLANEOUS MATERIALS

- A. Cleaning Materials:
 - 1. Detergent Solution: Solution prepared by mixing 2 cups of tetrasodium polyphosphate, 1/2 cup of laundry detergent that contains no ammonia, 5 quarts of 5 percent sodium hypochlorite bleach, and 15 quarts of warm water for each 5 gal. of solution required.
 - 2. Mildewcide: Provide commercial proprietary mildewcide or a solution prepared by mixing 1/3 cup of household detergent that contains no ammonia, 1 quart of 5 percent sodium hypochlorite bleach, and 3 quarts of warm water.
- B. Adhesives: Wood adhesives for exterior exposure, with minimum 15- to 45-minute cure at 70 deg F, in gunnable and liquid formulations as recommended by adhesive manufacturer for each type of repair.
- C. Fasteners: Fasteners of same basic metal as fastened metal unless otherwise indicated. Use metals that are noncorrosive and compatible with each material joined.
 - 1. Match existing fasteners in material and type of fastener unless otherwise indicated.
 - 2. Use concealed fasteners for interconnecting wood components.
 - 3. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
 - 4. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect adjacent materials from damage by historic treatment of wood windows.
- B. Clean existing wood windows of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.
- C. Condition replacement wood members and replacement windows to prevailing conditions at installation areas before installing.

3.2 HISTORIC TREATMENT PROCEDURES, GENERAL

- A. General: Have historic treatment of wood windows directed by a qualified historic treatment specialist. Ensure that historic treatment specialist's field supervisors are present when historic treatment of wood windows begins and during its progress. In treating historic items, disturb them as minimally as possible and as follows:
 - 1. Apply each product according to manufacturer's written instructions unless otherwise indicated.

2. Stabilize and repair wood windows to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
 3. Stop the progress of deterioration by removing coatings and applying borate preservative treatment before repair.
 4. Repair items in place where possible and retain as much original material as possible.
 5. Replace or reproduce historic items where indicated or scheduled.
 6. Make historic treatment of materials reversible whenever possible.
 7. Install temporary protective measures to protect wood window work that is indicated to be completed later.
- B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods such as sanding, wire brushing, or power tools except as indicated as part of the historic treatment program and as approved by Architect.
- C. Repair and Refinish Existing Hardware: Dismantle window hardware; repair and refinish it to original finish.
- D. Repair Wood Windows: Match existing materials and features, retaining as much original material as possible to perform repairs.
1. Unless otherwise indicated, repair wood windows by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
 2. Where indicated, repair wood windows by limited replacement matching existing material.
- E. Protection of Openings: Where sash or windows are indicated for removal, cover resultant openings with temporary enclosures so that openings are secure and weathertight during repair period.
- F. Identify removed windows, sash, and members with numbering system corresponding to window locations to ensure reinstallation in same location. Key windows, sash, and members to Drawings showing location of each removed unit. Permanently stamp units in a location that will be concealed after reinstallation.
- 3.3 GLAZING
- A. Remove cracked and damaged glass and glazing materials from openings and prepare surfaces for reglazing with similar glass unless otherwise specified.
 - B. Remove glass and glazing from openings and prepare surfaces for reglazing.
 - C. Reinstall glass with indicated glazing system and according to Division 08 Section "Glazing."
 - D. Disposal of Removed Glass: Remove from Owner's property and legally dispose of it unless otherwise indicated.
- 3.4 WOOD WINDOW PATCH-TYPE REPAIR
- A. General: Patch wood members that are damaged and exhibit depressions, holes, or similar voids, and that have limited rotted or decayed wood.
 1. Treat wood members with wood consolidant prior to application of patching compound. Allow treatment to harden before filling void with patching compound.
 2. Remove rotted or decayed wood down to sound wood.
 - B. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.
 1. Apply patching compound in layers as recommended by manufacturer until the void is completely filled.
 2. Finish patch surface to match contour of adjacent wood member. Sand patching compound smooth and flush, matching contour of existing wood member.

END OF SECTION

**SECTION 08 211
FACTORY FINISHED WOOD DOORS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Factory finished flush wood doors.
- B. Factory fitting doors to frames and factory machining for hardware.

1.2 SUBMITTALS

- A. Submit shop drawings indicating details of door construction.
- B. Submit door schedule indicating opening identifying symbol, location, sizes, door type and grade and indicate elevation fire classification marking, swing, light cutout sizes/locations and undercuts.
- C. Indicate dimensions and locations for cut-outs for locksets, latchsets, mortised hardware, lites and louvers.
- D. Submit certificates of compliance with fabrication and test requirements signed by authorized representative of the door manufacture.
- E. Submit sample of face veneer, 12 inch x 12 inch, with specified factory finish.
- F. Submit manufacturer's written warranting meeting the requirements of this section.

1.3 QUALITY ASSURANCE

- A. The Architectural Woodwork Institute (AWI) "Architectural Woodwork Quality Standards" 7th edition, Version 1.2, 1999 shall form the basis of reference and standard for defining acceptability of material and construction methods for work required of this Section.
- B. For fire-rated wood doors, provide wood doors which are identical in materials and construction to units tested in door and frame assemblies per ANSI/UL-10B and which are labeled and tested for ratings indicated by UL, Warnock Hersey or other testing and inspection agency acceptable to authorities having jurisdiction.

1.4 PRODUCT DELIVERY, STORAGE & HANDLING

- A. Protect doors during transit, storage and handling to prevent damage, soiling and deterioration. Comply with requirements of referenced standards and recommendations of NWWDA pamphlet "How to Store, Handle, Finish, Install and Maintain Wood Doors" as well as with the manufacturer's instructions.

1.5 WARRANTY

- A. Warrant materials and workmanship of wood doors for the life of the installation against defects materials and workmanship including the following:
 - 1. Delamination in any degree.
 - 2. Warp or twist of ¼ inch or more in any 3 feet – 6 inches x 7 feet – 0 inches section.
 - 3. Telegraphing of any part of core unit through face veneer to cause surface variation of 1/100 inch or more in any 3 inches span.
 - 4. Defects which may impair or affect performance of door in the purpose for which it is intended.
- B. Replacement under this warranty shall include materials, premachining, hanging, removal/installation of hardware and factory finishing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers:
 - 1. Algoma Hardwoods, Inc.
 - 2. Eggers Industries
 - 3. Marshfield Door Systems (Weyerhaeuser)
 - 4. VT Industries

2.2 MATERIALS

- A. Face Veneer Interior Solid-Core Doors:
 - 1. Grade: Premium, with Grade A faces.
 - 2. Species: Select White Birch.
 - 3. Cut: Rotary Cut.
 - 4. Match between Veneer Leaves: Book match.
 - 5. Assembly of Veneer Leaves on Door Faces: Balance match.

6. Pair and Set Match: Provide for doors hung in same opening.
 7. Core: Particleboard.
 8. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering.
- B. Adhesives:
1. Core: Type II or better, PS 51-71 containing no urea formaldehyde.
 2. Face veneers and Crossbands: Type I, PS 51-71, hot press process and containing no urea formaldehyde.
- C. Core:
1. Flush, solid core, non-rated: Particleboard Solid Core: ANSI 208.1-1987, grade 1-M-2 or 1-M-3, minimum density 45 pounds per cubic foot. (AWI Spec symbol PC-5 pr PC-7)

2.3 FABRICATION

- A. Manufacture doors where temperature and humidity controls insure a state of equilibrium between component parts during fabrication.
- B. Flush Particleboard Core Non-Rated:
1. Particleboard Core: Bonded to perimeter frame.
 2. Stiles and Rails:
 - a. Stiles: Continuous one piece not less than 1-3/8 inches thick; same species as face veneer.
 - b. Top and Bottom Rails: Hardwood not less than 1-1/8 inches thick.
 3. Crossbanding: Hardwood veneer, not less than 1/16 inch thick, applied to both faces of core, running full length and width of door.
- C. Factory Preparations:
1. Per NFPA 80, prepare fire door assemblies for locksets, latchsets, hinges, concealed closers, glass lites, louvers and astragals in conformance with the manufacturer's service procedures and under label service.
 2. Prefitting:
 - a. Swinging Doors: Standard clearance allowances of 1/8 inch at top, 1/8 inch at each side, and 1/4 inch at sill, 5/8 inch for floors with carpet.
 - b. Bottom clearance allowance of doors with threshold: 1/8 inch from bottom of door to top of threshold.
 - c. Clearance of meeting stiles of pairs of doors: 1/16 inch per door.
 3. Premachining:
 - a. Bevel on lock stile edges of single door or meeting stiles of pairs of doors: 1/8 inch in 2 inches.
 - b. Bevel on hinge side: 1/16 inch in 2 inches.
 - c. Premachine for specified finish hardware.
 - d. Premachine for cut-outs,
 - e. Premachining is not required for surface mounted hardware.
- D. Factory finish doors in accordance with AWI Quality Standards Section 1500. Factory finish to be water based stain and ultraviolet (UV) cured polyurethane sealer to comply with EPA Title 5 guidelines for Volatile Organic Compound(VOC) emissions limitations. Finish must meet or exceed performance standards of AWI TR-6 catalyzed polyurethane.
1. Verify finish and stain color with the Architect.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify frames are type required for door and installed as required for proper installation of doors. Fire rated doors shall be installed in corresponding fire rated frames.

3.2 HARDWARE PREPARATION

- A. Factory machine wood doors for hardware.
- B. Coordinate door frame schedule and templates with wood door manufacturer.
- C. Coordinate hardware templates and installation instructions. Reinforce doors where required for hardware.
- D. Rated doors and frames shall have hardware that was rated with them.

3.3 INSTALLATION

- A. Allow doors to become acclimated to finish building heat and humidity before hanging.
- B. In fitting for width, trim equally from both sides. In order to preserve the label on fire-rated doors, in fitting for width, trim following the door manufacturers requirements.
- C. Install wood doors to comply with manufacturer's installation instructions.

3.4 ADJUST AND CLEAN

- A. Replace and rehang doors which are hingebound and do not swing or operate freely.

END OF SECTION

**SECTION 08 212
STILE AND RAIL WOOD DOORS**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes exterior and interior stile and rail wood doors.
 - 1. Interior doors from available manufacturers or approved equal.
 - 2. Exterior doors to be custom made.

1.2 SUBMITTALS

- A. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and other pertinent data.

1.3 QUALITY ASSURANCE

- A. Quality Standard for Doors of Special Design and Construction: Comply with AWI's "Architectural Woodwork Quality Standards."
- B. Safety Glass: Provide products complying with testing requirements in 16 CFR 1201, for Category II materials, unless those of Category I are expressly indicated and permitted.

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 manufacturers:
 - 1. Algoma Hardwoods, Inc.
 - 2. Eggers Industries; Architectural Door Division.
 - 3. Pinecrest, Inc..

2.2 MATERIALS

- A. Assemble exterior doors and sidelites, including components, with wet-use adhesives.
- B. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea-formaldehyde resins.
- C. Lumber:
 - 1. Interior Doors: match factory finished flush wood doors.
 - a. All interior doors in Depot to be transparent finish..
 - 2. Exterior Doors: Spanish Cedar, opaque finish.

2.3 STILE AND RAIL DOORS OF SPECIAL DESIGN AND CONSTRUCTION

- A. Construction, General:
 - 1. Grade of Doors: Premium, Heavy Duty Performance Level.
 - 2. Interior Raised-Panel Door Thickness: 1-3/8 inches.
 - 3. Exterior Door Thickness: Match existing sample door, not less than 1-3/4 inches.

2.4 FABRICATION

- A. Fabricate stile and rail wood doors in sizes indicated for Project-site fitting.
- B. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting.
- C. Glazed Openings: Trim openings indicated for glazing with solid wood moldings, with one side removable. Miter wood moldings at corner joints.
- D. Factory machine doors for hardware that is not surface applied.

2.5 SHOP PRIMING

- A. Doors for Opaque Finish: Shop apply one coat of wood primer specified in Division 09 Section "Painting" to faces and edges of doors.
- B. Exterior Doors: Factory treat exterior doors after fabrication with water-repellent preservative to comply with WDMA I.S.4. Flash top of outswinging doors with manufacturer's standard metal flashing.
- C. Factory or field finishes opaque doors at contractor's option.
- D. Doors with transparent finish to be factory finished.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wood doors to comply with manufacturer's written instructions and with referenced quality standard, and as indicated.

- B. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.
 - 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering.
 - 2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Hardware: For installation, see Division 08 Section "Door Hardware."

END OF SECTION

**SECTION 08330
COILING DOORS AND GRILLES**

PART 1 - GENERAL**1.1 SUMMARY**

- A. Section Includes: manual push-up overhead rolling grilles and keyed mortise cylinders for coiling doors and grilles.
1. Comply with 087100 for Hardware.

1.2 SUBMITTALS

- A. Submit following items:
1. Product Data: Include published data and specific data prepared for this project.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum of three years experience in the fabrication and installation of coiling doors and grilles.
- B. Installer Qualifications: Authorized representative of the manufacturer.
- C. Single Source Responsibility: Provide door and grille, guides and related primary components from one manufacturer for each type of door and grille. Provide secondary components from source acceptable to manufacturer of primary components.
- D. Pre-Installation Conference: Schedule and convene a pre-installation conference just prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in labeled protective packages. Store and handle in compliance with manufacturer's instructions.

PART 2 - PRODUCTS**2.1 MANUFACTURER**

- A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include all with products equal to or better than the Basis of Design products:

Dynamic Closures Corporation
Telephone: 1-800-663-4599; Fax: 1-800-205-6665
Telephone: 1-613-938-1222; Fax: 1-613-933-9189
email: CustomerService@DynamicClosures.com

1. Acceptable Manufacturers Include
 - a. American Door
 - b. The Cookson Company, Inc.
 - c. Wayne Dalton

2.2 MODELS AND MATERIALS

- A. Model: Coiling Door - Vortex
- B. Curtain:
1. Horizontal Slats: Extruded aluminum interlocking flat slats. Slat width shall be 2 3/8 inch, depth shall be 1/2 inch and material thickness shall be .062 minimum. Slat shall be extruded with a "V" groove line on center to give the appearance of a 1 1/4 inch slat.
 2. Bottom Bar: Heavy extruded tubular aluminum.
- C. Guides: Heavy extruded aluminum shape 3 inch by 1 7/16 inch with upset shoulders for curtain retention. Each guide will be fitted with vinyl stripping for quiet operation and to cushion both sides of curtain.
1. Telescoping aluminum tubes and steel channels.
- D. Finish-Exposed Aluminum Parts: Selected by Architect from manufacturers available colors: Exposed 5/8 inch narrow edge of links are not anodized. Note: Telescoping tubes mill finish. Counterbalance: Helical torsion spring assembly set in aluminum extruded 5 inch barrel to support curtain with a maximum deflection of .03 inch per foot of curtain width. Shaft width does not extend past back of guide.
- E. Bracket Plates: Minimum 3/16 inch steel plate to support counterbalance assembly and curtain. Steel plates are offset and measure 15 inches in height by 11 inches in depth.
- F. Locking:

1. Convenient Smart-Lock System with centered thumb turn cylinder coil side including protection pattern in curtain, keyed cylinder exterior.

G. H. Operation:

1. Manual push-up.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supports and other conditions under which doors are to be installed.
- B. Coordinate with responsible entity to correct unsatisfactory conditions and do not proceed with installation until conditions are corrected.

3.2 INSTALLATION

- A. Follow manufacturer's installation instructions and approved shop drawings.

3.3 ADJUSTING AND CLEANING

- A. Test operation of Grille and adjust as necessary to provide smooth and proper operation.
- B. Clean exposed surfaces using manufacturers recommended cleanser.

3.4 DEMONSTRATION

- A. Instruct Owner's personnel in proper operating and maintenance procedures.

END OF SECTION

**SECTION 08520
SECONDARY GLAZING/STORM WINDOW**

PART 1 - GENERAL**1.1 SUMMARY**

- A. All aluminum windows of the types and sizes required for windows indicated. Approximate sizes may be shown on plans – field measure for ordering.
- B. Provide with all necessary hardware, fasteners and miscellaneous equipment for a complete installation as recommended by the manufacturer.

PART 2 - PRODUCTS**2.1 MANUFACTURER:**

- A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include all with products equal to or better than the Basis of Design products:

ALLIED WINDOW, INC.
11111 Canal Road
Cincinnati, Ohio 45241
(800) 445-5411
(513) 559-1212
(513) 559-1883 (Fax)

WEBSITE
www.alliedwindow.com
www.invisiblestorms.com

E-MAIL ADDRESS
info@alliedwindow.com

- 1. Additional Acceptable Manufacturers Include:
 - a. Historic Invisible Storm Windows, Loveland, OH 513-891-7858
 - b. Climate Seal Preservation Series Window Insert, Chaska, MN 877-773-7379
- B. Fixed Secondary Glazing shall be model MOL
- C. Operable Secondary Glazing shall be model MOL-OP
- 2.2 ALLOYS**
 - A. Aluminum shall be of commercial quality and of proper alloy for window construction free from defects impairing strength and durability. All straight extruded sections shall be of 6063-T5 alloy and temper and shall have a minimum ultimate tensile strength of 22,000 pounds per square inch and a yield of 16,000 pounds per square inch.
- 2.3 WINDOW MEMBERS.**
 - A. All sash members shall be of extruded aluminum with a 3/8 inch x 1 inch dimension. All extrusions shall be of sufficient strength to perform as designed. Window members shall have a nominal wall thickness of not less than .062 inch. All corner keys shall be of extruded aluminum. High-energy foam-backed magnetic tape shall be applied to jamb rails of removable panel/assembly.
- 2.4 FASTENERS.**
 - A. All screws and other miscellaneous fastening devices incorporated shall be zinc plated, cadmium plated or other non-corrosive metals compatible with aluminum.
- 2.5 HARDWARE/MAGNETIC SEAL.**
 - A. Head receptor to be extruded aluminum U-channel with dimensions of ½ inch x 5/8 inch and with nominal wall thickness of not less than .046 inch. The magnetic seal is to be accomplished by the use of one (1) of these jamb stop alternatives as selected by architect from submittals:
 - 1. Foam-backed steel tape applied to U-channel noted above
 - 2. Foam-backed steel tape applied directly to prime window frame system
 - 3. Foam-backed steel tape applied to aluminum angle
 - 4. Steel angle or channel
- 2.6 WEATHERSTRIPPING.**
 - A. Bottom rail of panel/assembly shall incorporate flexible “sill-seal” weatherstripping. Operating track jamb members shall be lined with pile weatherstripping equal to Stan-pro #525-160.

PART 3 - EXECUTION

3.1 ASSEMBLY

- A. All windows shall be assembled in a secure and workmanlike manner. The master frame and insert frame(s) shall be of mitered head and sill. Frame rails and stiles shall be neatly joined together using extruded aluminum corner keys staked in place.

3.2 SASH

- A. Sash(s) shall be removable and be equipped with a full bottom rail lift handle.
- B. The operable bottom sash shall be removable and be equipped with a full bottom rail lift handle. Heavy-duty spring-loaded latches shall be provided for variable sash positions for ventilation.

3.3 STACKING

- A. Horizontal stacking mullion(s) mounted to wood-reinforced jamb channels with machine bolts and locking nuts.

3.4 FINISH

- A. The exposed surfaces of all aluminum members shall be clean and free from serious surface blemishes. Custom color finish to be two-part polyurethane paint (air dried).

3.5 SCREEN (at operable units only)

- A. Extruded screen insert frame(s) (3/8 inch x 1-1/16 inches) with extruded aluminum corner keys shall be provided. Standard screen cloth is charcoal aluminum 18 x 16 mesh securely held in frame with vinyl spline.

3.6 GLASS AND GLAZING

- A. Glass shall be not less than "B" quality. Standard factory glazing shall be "DSB" (1/8"). Optional use of 5/32 inch, 3/16 inch, or tempered glass shall be dictated by size of panels, code requirements, or project specifications. See drawings for glass requirements.
- B. GLAZING MATERIAL. Glass shall be held in place with removable and reusable vinyl glazing splines. Vinyl shall be manufactured from virgin polyvinyl chloride. All corners shall be neatly mitered.

3.7 INSTALLATION

- A. The installer shall securely fasten windows in place to a straight, plumb and level condition, without distortion of the windows and shall make final adjustments for proper operation in accordance with the manufacturer's instructions.

3.8 WARRANTY

- A. Manufacturer shall provide a five (5) year warranty against faulty materials, paint and workmanship.

END OF SECTION

**SECTION 08710
DOOR HARDWARE**

PART 1 – GENERAL**1.1 SECTION INCLUDES**

- A. Door hardware for wood doors.
- B. Where items of hardware are not definitely specified and are required for the intended service, such omission or other discrepancy shall be directed to the Architect prior to the bid date for clarification by addendum. Otherwise provide such items in the type and quantity for the appropriate service intended.

1.2 SUBMITTALS

- A. The door hardware schedule format shall be consistent with recommendations for a vertical format set forth in the Door & Hardware Institute's (DHI) publication "Sequence and Format for the Hardware Schedule". **(Handwritten schedules will not be acceptable.)** Door hardware sets shall be consolidated to group multiple door openings which share similar hardware requirements. Schedule shall include the following information:
 - 1. Door number, location, size, handing, and rating.
 - 2. Door and frame material, handing.
 - 3. Degree of swing.
 - 4. Manufacturer
 - 5. Product name and catalog number
 - 6. Function, type and style
 - 7. Size and finish of each item
 - 8. Mounting heights
 - 9. Explanation of abbreviations, symbols, etc.
 - 10. Numerical door index, indicating the hardware set/ group number for each door.
- B. The schedule shall be prepared under the direct supervision of a certified architectural hardware consultant (AHC). The AHC shall attend meetings related to the project when requested by the Architect.
- C. Review drawings from related trades as required to verify compatibility with specified hardware. Indicate unsuitable or in compatible items, and proposed substitutions in the door hardware schedule.
- D. Submit with the first submittal, a list of required lead times for door hardware items.
- E. After final approved schedule is returned, transmit corrected copies for distribution and field use in quantities required by Division 1 - General Requirements.
- F. Submit approved door hardware schedules, template lists, and pertinent templates as requested by related trades.
- G. After receipt of approved door hardware schedule, the door hardware supplier shall initiate a meeting including the Owner's Representative to determine keying requirements. Upon completion of the initial key meeting, the door hardware supplier shall prepare a key schedule with symbols and abbreviations as set forth in the Door and Hardware Institute's publication "Keying Procedures, Systems, and Nomenclature". Submit copies of the Owner approved key schedule for record and field use in quantities required by Division 1 - General Requirements.

1.3 QUALITY ASSURANCE

- A. This section may not deal individually with minute items such as components, parts, and devices which may be required to produce the door hardware performance specified. Provide such items where required, whether or not specifically identified.
- B. Obtain each type of door hardware (hinges, latch & locksets, exit devices, closers, etc.) from a single manufacturer.

1.4 TEMPLATES

- A. The door hardware supplier shall furnish templates and other information as may be required to the fabricators of the doors and frames. This data is required to assist the fabricators in making proper cutouts, mortises, reinforcements, and other preparations as required to properly receive the door hardware.

- B. The templates and/or physical door hardware, as required, shall be shipped prepaid to the fabricators.

1.5 WARRANTY

- A. Door hardware items shall be warranted against defects in material and workmanship as set forth in Division 1 - General Requirements.
- B. Door hardware shall be warranted by the manufacturers to be free from defects in materials and workmanship for a period of two (2) years from substantial completion of the project.
 - 1. Exception: Mechanical closers shall be warranted for ten (10) years from date of substantial completion.
 - 2. Exception: Ball bearing hinges shall be warranted for lifetime of the installation.
 - 3. Exception: Exit devices shall be warranted for five (5) years fro date of substantial completion.
- C. Repair, replace, or otherwise correct deficient materials and workmanship without additional cost to the Owner.

PART 2 - PRODUCTS

2.1 FASTENERS

- A. Install door hardware with only fasteners provided by the manufacturer for use with the specific product and according to the manufacturer's written instructions.
- B. Exposed fasteners shall be Phillips head or as otherwise specified, and shall match the finish of the adjacent door hardware. Fasteners exposed to the weather shall be non-ferrous or stainless steel. Provide correct fasteners to accommodate surrounding conditions.
- C. Coordinate required reinforcements for doors and frames. Obtain approval of the Architect prior to providing through-bolts. Provide through-bolts as required for materials not readily reinforced.
- D. Provide self-tapping (TEC) screws for attachment of sweeps and stop-applied weatherstripping.

2.2 BUTT HINGES

- A. Acceptable manufacturers and respective catalog numbers:

	Ives	Stanley	Hager	McKinney	Bommer
Heavy weight, ball bearing,	5BB1HW	FBB199	BB1199	T4B3386	
exterior exposure, non-ferrous or stainless steel					
- B. Provide hinges for exterior doors, fabricated from stainless steel. Hinges for interior doors shall be fabricated from steel.
- C. Provide hinges to template standards.

2.3 LOCKS AND LATCHES

- A. Acceptable manufacturers and catalog numbers:

	Falcon	Yale	Sargent
	(FAL)	(YAL)	(SAR)
Grade 1	T Series	5400L	11 Line
Cylindrical		N	
- B. Unless otherwise specified, locks and latches shall have:
 - 1. 2-3/4 inch Backset
 - 2. 1/2" minimum throw latchbolt
 - 4. 6 pin cylinders
 - 5. ANSI A115.2 strikes
- C. Provide guarded latchbolts for locksets, and latchbolts with sufficient throw to maintain fire rating of both single and paired door assemblies.
- D. Length of strike lip shall be sufficient to clear surrounding trim.
- E. Provide wrought boxes for strikes at inactive doors, wood frames, and metal frames without integral mortar covers.
- F. Levers shall match Falcon "Quantum".

2.4 EXIT DEVICES

A. Acceptable manufacturers and catalog numbers:

	Falcon	Sargent	Yale
	(FAL)	(SAR)	(YAL)
Wide Stile, Cross Bar	XX Series	90 Series	1500 Series

- B. Exit devices shall be equipped with a sound-dampening feature to reduce touch pad return noise.
- C. Exit devices shall be furnished with flush end caps to reduce potential damage from impact.
- D. Furnish strikes and adapter plates to accommodate door and frame conditions. Furnish narrow style series devices in lieu of wide stile series devices where strikes will not accommodate door and frame conditions.
- E. Coordinate with related trades to insure adequate clearance and reinforcement is provided in doors and frames. Furnish thru bolts as required.
- F. Exit devices shall be furnished with trim designs to match other lever and pull designs used on the project.

2.5 CLOSERS

A. Acceptable manufacturers and catalog numbers:

		Sargent	Yale
	Falcon (FAL)	(SAR)	(YAL)
Medium duty	SC80 Series	1431 Series	3501

- B. Closers shall utilize a stable fluid withstanding temperature range of +120deg F to -30deg F without seasonal adjustment of closer speed to properly close the door. Provide closers for fire-rated doors with temperature stabilizing fluid that complies with standards UL10C.
- C. Unless otherwise specified, door closers shall have full covers and separate adjusting valves for sweeps, latch, and backcheck.
- D. Provide closers complete with mounting brackets and cover plates as required by door and frame conditions, and by adjacent hardware.

F. Pressure relief valves, PRV's, are not acceptable.

2.6 WEATHERSTRIP, GASKETING

A. Acceptable manufacturers and respective catalog numbers:

	Pemko	NGP	Hager
Weatherstrip	2892	700E	881SS
Sweeps	345	C627	770SB

B. Provide weatherstripping at exterior doors and where specified.

2.7 THRESHOLDS

A. Acceptable manufacturers and respective catalog numbers:

	Pemko	NGP	Hager
Thresholds	171	425	404S

B. Hardware supplier shall verify finish floor conditions and coordinate proper threshold as required to insure a smooth transition between threshold and interior floor finish.

2.8 FLUSH BOLTS AND DUST PROOF STRIKES

A. Acceptable manufacturers and catalog numbers:

	Ives (IVE)	Door Controls (DCI)	Hager (HAG)
Dust Proof Strike	DP2	82	280X
Manual Flush Bolt (Wood Door)	FB458	790F	283D

2.9 PROTECTION PLATES

A. Acceptable manufacturers and catalog numbers:

Ives (IVE)	Hager (HAG)	Burns (BUR)	IPC (IPC)
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- B. Furnish 10 inch high kick plates. Metal protective plates shall be 0.050 inch thick satin stainless steel
- C. Protective plates shall be 2 inch less door width. Protective plates shall be beveled 4 sides and screws counter sunk.

2.10 FINISHES AND BASE MATERIALS

- A. Typical hardware finish, oil rubbed bronze, dependent upon base metal:
 - 1. BHMA Finish Standard #613 (US Standard Finish US10B);
 - 22. BHMA Finish Standard #640 (US Standard Finish US10B);

2.11 KEYING

- A. Provide locks and cylinders utilizing a patented keyway to prevent manufacturing and distribution of aftermarket key blanks by anyone other than factory authorized dealers.
- B. Locks shall be keyed as directed by the Owner to a new restricted, patented master key system.
- C. Keying shall be by lock manufacturer where permanent records shall be kept.
- D. Provide a total of two (2) keys per cylinder. Actual cut keys to be determined by owner.
- E. Master keys and control keys to be delivered by registered mail to the Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of door hardware, the door hardware installer shall examine door frame installation to insure frames have been set square and plumb. The installer shall examine doors, door frames, and adjacent wall, floor, and ceiling for conditions, which would adversely effect proper operation and function of door assemblies. Do not proceed with door hardware installation until such deficiencies have been corrected.

3.2 INSTALLATION

- A. Install door hardware in accordance with the approved hardware schedule and the manufacturer's instructions for installation and adjustment.
- B. Set units level, plumb and true to the line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- C. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accord with industry standards.
- D. Drill appropriate size pilot holes for door hardware attached to wood doors and frames.
- E. Shim doors as required to maintain proper operating clearance between door and frame.
- F. Use only fasteners supplied by or approved by the manufacturer for each respective item of door hardware.
- G. Mortise and cut to close tolerance and conceal evidence of cutting in the finished work.
- H. Where necessary, adjust doors and door hardware to eliminate binding between strike and latchbolt. Doors shall not rattle.
- I. Compress sweep during installation as recommended by sweep manufacturer to facilitate a water resistant seal.

3.3 ADJUSTMENT AND CLEANING

- A. Door hardware shall be left clean and in good operation. Door hardware found to be disfigured, defective, or inoperative shall be repaired or replaced.
- B. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.

3.4 DOOR HARDWARE SCHEDULE

- A. The following schedule of door hardware groups is intended to describe opening function.

Hardware Group No. B01

For use on door(s):

106B

Provide each SGL door(s) with the following:

Quantity	Description	Model Number	Finish Mfr
1	EA CYLINDER	CYLINDERS AS REQUIRED	
1		BALANCE OF HARDWARE BY DOOR	

Hardware Group No. C01

For use on door(s):

106A

111A

111B

Provide each SGL door(s) with the following:

Quantity	Description	Model Number	Finish Mfr
3	EA HINGE	5BB1 4.5 X 4.5	IVE
1	EA CLASSROOM LOCK	T381	FAL
1	EA WALL STOP	WS407CCV	IVE
3	EA SILENCER	SR64	GRY IVE

Hardware Group No. C02

For use on door(s):

109A

Provide each SGL door(s) with the following:

Quantity	Description	Model Number	Finish Mfr
3	EA HINGE	5BB1 4.5 X 4.5	IVE
1	EA CLASSROOM LOCK	T381	FAL
1	EA SURFACE CLOSER	SC80 RW/PA	FAL
1	EA KICK PLATE	8400 10 inch X 2 inch LDW	IVE
1	EA WALL STOP	WS407CCV	IVE
3	EA SILENCER	SR64	GRY IVE

Hardware Group No. K02

For use on door(s):

101B

Provide each SGL door(s) with the following:

Quantity	Description	Model Number	Finish Mfr
3	EA HINGE	5BB1 4.5 X 4.5	IVE
1	EA OFFSET DOOR PULL	8190-0	IVE
1	EA PUSH PLATE	8200 6 inch X 16 inch	IVE
1	EA SURFACE CLOSER	SC80 RW/PA	FAL
3	EA SILENCER	SR64	GRY IVE

Hardware Group No. P01

For use on door(s):

105A

Provide each SGL door(s) with the following:

Quantity	Description	Model Number	Finish Mfr
3 EA	HINGE	5BB1 4.5 X 4.5	IVE
1 EA	PASSAGE SET	T101S	FAL
1 EA	WALL STOP	WS407CCV	IVE
3 EA	SILENCER	SR64	GRY IVE

Hardware Group No. P02

For use on door(s):

109B

Provide each SGL door(s) with the following:

Quantity	Description	Model Number	Finish Mfr
3 EA	HINGE	5BB1 4.5 X 4.5	IVE
1 EA	PASSAGE SET	T101S	FAL
1 EA	SURFACE CLOSER	SC80 RW/PA	FAL
1 EA	WALL STOP	WS407CCV	IVE
3 EA	SILENCER	SR64	GRY IVE

Hardware Group No. S04

For use on door(s):

104A

Provide each PR door(s) with the following:

Quantity	Description	Model Number	Finish Mfr
6 EA	HINGE	5BB1 4.5 X 4.5	IVE
2 EA	MANUAL FLUSH BOLT	FB358	IVE
1 EA	DUST PROOF STRIKE	DP2	IVE
1 EA	STOREROOM LOCK	T581	FAL
2 EA	KICK PLATE	8400 10 inch X 2 inch LDW	IVE
2 EA	WALL STOP	WS407CCV	IVE
2 EA	SILENCER	SR64	GRY IVE

Hardware Group No. S04A

For use on door(s):

110A

Provide each PR door(s) with the following:

Quantity	Description	Model Number	Finish Mfr
6 EA	HINGE	5BB1 4.5 X 4.5	IVE
2 EA	MANUAL FLUSH BOLT	FB458	IVE
1 EA	DUST PROOF STRIKE	DP2	IVE
1 EA	STOREROOM LOCK	T581	FAL
2 EA	KICK PLATE	8400 10 inch X 2 inch LDW	IVE
2 EA	SILENCER	SR64	GRY IVE

Hardware Group No. T01

For use on door(s):

102A 103A

Provide each SGL door(s) with the following:

Quantity	Description	Model Number	Finish Mfr
3 EA	HINGE	5BB1 4.5 X 4.5	IVE
1 EA	PRIVACY SET	T301S	FAL
1 EA	WALL STOP	WS407CCV	IVE
3 EA	SILENCER	SR64	GRY IVE

Hardware Group No. X02A

For use on door(s):

108B 112A

Provide each SGL door(s) with the following:

Quantity	Description	Model Number	Finish Mfr
3 EA	HINGE	5BB1 4.5 X 4.5 NRP	IVE
1 EA	FIRE EXIT DEVICE	XX-R-L	FAL
1 EA	CYLINDER	CYLINDERS AS REQUIRED	
1 EA	SURFACE CLOSER	4041-PA	LCN
1 EA	SURFACE CLOSER	SC80 SS	FAL
1 EA	DRIP CAP	16A - OPENING WIDTH + 4 inches	NGP
1 EA	DOOR SWEEP	200NA	NGP
1 EA	DOOR SWEEP	C627A	NGP
1 EA	THRESHOLD	425E	NGP

Hardware Group No. X02N

For use on door(s):

101A

Provide each SGL door(s) with the following:

Quantity	Description	Model Number	Finish Mfr
3 EA	HINGE	5BB1 4.5 X 4.5 NRP	IVE
1 EA	FIRE EXIT DEVICE	XX-R-K-NL	FAL
1 EA	CYLINDER	CYLINDERS AS REQUIRED	
1 EA	SURFACE CLOSER	4041-PA	LCN
1 EA	SURFACE CLOSER	SC80 SS	FAL
1 EA	DRIP CAP	16A - OPENING WIDTH + 4 inches	NGP
1 EA	DOOR SWEEP	200NA	NGP
1 EA	DOOR SWEEP	C627A	NGP
1 EA	THRESHOLD	425E	NGP

END OF SECTION

**SECTION 08800
GLAZING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
1. Doors.
 2. Windows.
 3. Glazed entrances.

1.2 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.3 QUALITY ASSURANCE

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

PART 2 - PRODUCTS**2.1 GLASS PRODUCTS, GENERAL**

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear), non-reflective.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AFG Industries, Inc.; Krystal Klear.
 - b. Guardian Industries Corp.; Ultrawhite.
 - c. Pilkington North America; Optiwhite.
 - d. PPG Industries, Inc.; Starphire.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear), non-reflective; of kind and condition indicated.

2.3 GLAZING SEALANTS

- A. General:
1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.

4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

2.4 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.5 GLASS TYPES (Provide fully tempered float glass where required by I.B.C. 2006.)

- A. Glass Type GL-1: 0.25 inch, clear, non reflective.
 1. Provide safety glazing only at hazardous locations per the requirements of Chapter 24-IBC 2006 include labeling of safety glass where provided.
- B. Glass Type GL-2: Existing to remain.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. 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 substances immediately as recommended in writing 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 than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

3.3 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Separate and dispose of waste in accordance with the Project's Waste Management Policy.

END OF SECTION

**SECTION 09 250
GYPSUM BOARD**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum board, type X unless otherwise indicated.
 - a. Moisture resistant in areas exposed to moisture including kitchen and toilet rooms.

1.2 DEFINITIONS

- A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.3 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 RECYCLED CONTENT OF GYPSUM PANELS

- A. Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 5 percent by weight.

2.2 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
 - 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 Gypsum Co.
 - b. James Hardie Gypsum
 - c. National Gypsum Company.
 - d. USG Corporation.

B. Type X:

- 1. Thickness: 5/8 inch.
- 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

C. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

- 1. Core: 5/8 inch, Type X.
- 2. Long Edges: Tapered.

2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. Expansion (control) joint.

2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - 4. Finish Coat: For third coat, use setting-type, sandable topping compound.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."
 - 1. Provide sealants that have a VOC content of 250g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- D. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members, or provide control joints to counteract wood shrinkage.

3.2 APPLYING INTERIOR GYPSUM BOARD

3.3 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings or if not indicated then according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
 - 2. Bullnose Bead: Use where indicated.
 - 3. LC-Bead: Use at exposed panel edges.

3.4 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.

3.5 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

**SECTION 09640
WOOD FLOORING**

PART 1 - GENERAL

- 1.1 SUMMARY
- A. Section includes:
1. New wood flooring.
- 1.2 ACTION SUBMITTALS
- A. Product Data: For each type of product indicated.
- B. Samples: For each type of wood flooring and accessory.
- 1.3 QUALITY ASSURANCE
- A. Hardwood Flooring: Comply with NOFMA's "Official Flooring Grading Rules" for species, grade, and cut.
- 1.4 PROJECT CONDITIONS
- A. Conditioning period begins not less than seven days before wood flooring installation, is continuous through installation, and continues not less than seven days after wood flooring installation.
1. Environmental Conditioning: Maintain an ambient temperature between 65 and 75 deg F and relative humidity planned for building occupants in spaces to receive wood flooring during the conditioning period.
 2. Wood Flooring Conditioning: Move wood flooring into spaces where it will be installed, no later than the beginning of the conditioning period.
 - a. Do not install flooring until it adjusts to relative humidity of, and is at same temperature as, space where it is to be installed.
 - b. Open sealed packages to allow wood flooring to acclimatize immediately on moving flooring into spaces in which it will be installed.
- B. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.
- C. Install factory-finished wood flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS –New Wood
- A. FloorScore Compliance: Wood floors shall comply with requirements of FloorScore Standard.
- B. Low-Emitting Materials: Wood flooring systems shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 2.2 WOOD FLOORING
- A. New Solid-Wood Flooring: Kiln dried to 6 to 9 percent maximum moisture content, tongue and groove and end matched, and with backs channeled.
1. Species and Grade: MFMA-RL First Grade hard maple
 2. Finishing: Factory.
 3. Thickness: 3/4 inch.
 4. Face Width: to match existing approximately 3-1/8 Inches.
 5. Lengths: Manufacturer's standard.
- 2.3 FACTORY FINISHING
- A. Finish: UV urethane or Acrylic impregnated.
1. Color: As selected by Architect in manufacturer's full range.
- 2.4 ACCESSORY MATERIALS
- A. Asphalt-Saturated Felt: ASTM D 4869, Type II.
- B. Wood Flooring Adhesive: Mastic recommended by flooring and adhesive manufacturers for application indicated.
1. Adhesive shall have a VOC content of not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Fasteners: As recommended by manufacturer, but not less than that recommended in NWFA's "Installation Guidelines: Wood Flooring."
- D. Thresholds and Saddles: To match wood flooring. Tapered on each side.
- E. Reducer Strips: To match wood flooring. 2 inches wide, tapered, and in thickness required to match height of flooring.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Cementitious Slabs: Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than two tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Perform anhydrous calcium chloride test per ASTM F 1869, as follows:
 - 1) Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 pounds of water/1000 square feet. in 24 hours.
 - b. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - B. Remove coatings, including curing compounds, and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - C. Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with flooring manufacturer's written installation instructions, but not less than applicable recommendations in NWFA's "Installation Guidelines: Wood Flooring."
- B. Provide expansion space at walls and other obstructions and terminations of flooring as recommended by flooring manufacturer.
- C. Vapor Retarder: Comply with NOFMA's "Installing Hardwood Flooring" for vapor retarder installation and the following:
 1. Wood Flooring Nailed to Wood Subfloor: Install flooring over a layer of asphalt-saturated felt.
- D. Solid-Wood Flooring: Blind nail or staple flooring to substrate.

3.3 PROTECTION

- A. Protect installed wood flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.

END OF SECTION

**SECTION 09653
RESILIENT WALL BASE AND ACCESSORIES**

PART 1 - GENERAL**1.1 SUMMARY**

- A. This Section includes the following:

1. Wall base.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.

B. Samples: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

1.3 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.

2. During installation.

3. 48 hours after installation.

B. After post installation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

1.4 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. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 COLORS AND PATTERNS

- A. Colors and Patterns: As selected from manufacturer's full range.

2.3 RESILIENT WALL BASE

- A. Wall Base: ASTM F 1861.

1. AFCO-USA, American Floor Products Company, Inc.;

2. Armstrong World Industries, Inc.;

3. Johnsonite.;

4. Mondo Rubber International, Inc.;

5. Nora Rubber Flooring, Freudenberg Building Systems, Inc.;

B. Type (Material Requirement): TS (rubber, vulcanized thermoset).

C. Group (Manufacturing Method): I (solid, homogeneous) or II (layered).

D. Style: Cove (with top-set toe).

E. Minimum Thickness: 0.125 inch.

F. Height: 4 inches.

G. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.

H. Outside Corners: Job formed or premolded.

I. Inside Corners: Job formed or premolded.

J. Surface: Smooth.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturers for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- C. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- D. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 - 1. Do not install resilient products until they are the same temperature as the space where they are to be installed.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 RESILIENT WALL BASE INSTALLATION

- A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- D. Do not stretch wall base during installation.
- E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.
- F. Premolded Corners: Install premolded corners before installing straight pieces.
- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

3.3 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
 - a. Do not wash surfaces until after time period recommended by manufacturer.
- B. Protect resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION

**SECTION 09 911
EXTERIOR PAINTING**

PART 1 - GENERAL**1.1 SUMMARY**

- A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
1. Galvanized metal.
 2. Ferrous metal.
 3. Wood.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each finish and for each color and texture required.
- C. Product List: Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.3 QUALITY ASSURANCE

- A. MPI Standards:
1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
- B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 square feet.
 - b. Other Items: Architect will designate items or areas required.
 2. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
1. Quantity: Furnish an additional 1 gallon of each material and color applied.

PART 2 - PRODUCTS**2.1 PAINT, GENERAL**

- A. Acceptable manufacturers
1. Benjamin Moore & Co.
 2. Devoe Paint Co.
 3. Diamond Vogel
 4. Sherwin Williams Co.
 5. Pittsburgh Paint
- B. Material Compatibility:
1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
 3. Paint materials selected for each type of surface shall be the product of a single manufacturer.
 4. Thinners, when used, shall be only those thinners recommended for that purpose by the manufacturer of material to be thinned.
- C. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION AND APPLICATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.3 EXTERIOR PAINTING SYSTEMS

- A. General: Products listed are based on Diamond Vogel (unless otherwise noted). Equivalent products of acceptable manufacturers (listed in Part 2) are also acceptable.
- B. Colors shall be selected from manufacturer's full range of available colors.
- C. **EXT-1:** (Three colors)
 - 1. Prime Coat: one coat BU-Series Weather-Plate.
 - 2. Topcoat: two coats BH-Series Exterior Latex Semi-Gloss.
- D. **EXT-2:** (Single Color)
 - 1. Prime Coat: one coat BU-Series Weather-Plate.
 - 2. Topcoat: two coats BN-Series Exterior Latex Mid-Sheen.
- E. **EXT-3:** (Single Color)
 - 1. Prime Coat: one coat MC-Series Semi-gloss Latex Primer.
 - 2. Topcoat: two coats MC-Series Semi-gloss Finish.
- F. **EXT-4:** (Single Color)
 - 1. Prime Coat: Provided at factory or 1 ct V-Cote 200 Acrylic Maintenance Primer.
 - 2. Topcoat: two coats MH-Series Nu-Cling 100% acrylic enamel, gloss. (Verify compatibility with factory primer, use topcoat that is compatible with factory primer)

3.4 SCHEDULE OF ITEMS TO BE PAINTED

- A. Types of exterior surfaces to be painted in this project include but are not limited to:
 - 1. Wood, Composite Wood, and Panel Surfaces: EXT-1
 - 2. Wood Shingles: EXT-2
 - 3. Metal Fabrications (previously painted): EXT-3
 - 4. Galvanized Metal (with or without factory paint grip): EXT-4

END OF SECTION

**SECTION 09 912
INTERIOR PAINTING**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
1. Steel.
 2. Wood.
 3. Plaster and Gypsum board.
 4. Epoxy paints in utility rooms, restrooms and food prep areas.
 5. Color selection
 - a. It is the intent to match historic motifs and colors schemes discovered during paint removal and prep operations. Historic color schemes will be utilized with up to three colors per space.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each finish and for each color and texture required.

1.3 QUALITY ASSURANCE

- A. Provide qualified workers trained and experienced in the preparation for painting of wood and metal surfaces in historic structures.
- B. MPI Standards:
1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
- C. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 square feet.
 - b. Other Items: Architect will designate items or areas required.
 2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
 3. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
1. Quantity: Furnish an additional 1 gallon of each material and color applied.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

- A. Material Compatibility:
1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.

2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
 3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 4. Shellacs, Pigmented: VOC not more than 550 g/L.
 5. Flat Topcoat Paints: VOC content of not more than 50 g/L.
 6. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
 7. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 8. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
 9. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
 10. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.
- C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 2. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.
 - b. Acrylonitrile.
 - c. Antimony.
 - d. Benzene.
 - e. Butyl benzyl phthalate.
 - f. Cadmium.
 - g. Di (2-ethylhexyl) phthalate.
 - h. Di-n-butyl phthalate.
 - i. Di-n-octyl phthalate.
 - j. 1,2-dichlorobenzene.
 - k. Diethyl phthalate.
 - l. Dimethyl phthalate.
 - m. Ethylbenzene.
 - n. Formaldehyde.
 - o. Hexavalent chromium.
 - p. Isophorone.
 - q. Lead.
 - r. Mercury.
 - s. Methyl ethyl ketone.
 - t. Methyl isobutyl ketone.
 - u. Methylene chloride.
 - v. Naphthalene.
 - w. Toluene (methylbenzene).
 - x. 1,1,1-trichloroethane.
 - y. Vinyl chloride.
- D. Colors: As selected by Architect from manufacturer's full range.
- 2.2 PRIMERS/SEALERS
- A. Interior Latex Primer/Sealer: MPI #50.
 1. VOC Content: E Range of E2.
 2. Environmental Performance Rating: EPR 2.
 - B. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.
- 2.3 METAL PRIMERS
- A. Rust-Inhibitive Primer (Water Based): MPI #107.
 1. VOC Content: E Range of E3.
 2. Environmental Performance Rating: EPR 3.

2.4 WOOD PRIMERS

- A. Interior Latex-Based Wood Primer: MPI #39.
 1. VOC Content: E Range of E3.
 2. Environmental Performance Rating: EPR 3.

2.5 LATEX PAINTS

- A. Institutional Low-Odor/VOC Latex (Eggshell): MPI #145 (Gloss Level 3).
 1. VOC Content: E Range of E3.
 2. Environmental Performance Rating: EPR 4.5.
- B. Institutional Low-Odor/VOC Latex (Semigloss): MPI #147 (Gloss Level 5).
 1. VOC Content: E Range of E2.

2.6 TRANSPARENT FINISHES

- A. Varnish, Interior, Polyurethane, Oil Modified, Satin (Stain and Top): MPI #57 (Gloss Level 4)
 1. VOC Content: E Range of E2.

2.7 CALCIMINE RECOATER - AUDITORIUM CEILING

- A. Ready-mix Calci-Coater, tinted to match latest color scheme identified on attached color analysis at auditorium ceiling.
 - a. The Savogran Company
Product line: Olde Yankee Towne
P.O. Box 130, Norwood, MA 02062
(800) 225-9872
www.sclsterling.com
 2. For use over old calcimine paint, tint-able, VOC compliant product formulated to adhere to old calcimine paint. Prep and apply product in compliance with manufacturer's instructions and recommendations.
 3. Spot prime stained and bare areas.
 4. Provide full prime coat and one finish coat.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION AND APPLICATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
 1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.

- c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 - 2. Electrical Work:
 - a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.
 - E. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
 - F. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
- 3.3 INTERIOR PAINTING SCHEDULE
- A. Fiberglass Substrates
 - 1. Latex MPI INT 6.7A (Gloss Level 5)
 - B. Steel Substrates:
 - 1. Institutional Low-Odor/VOC Latex System: MPI INT 5.1S.
 - a. Prime Coat: Rust-inhibitive primer (water based).
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).
 - C. Dressed Lumber Substrates:
 - 1. Architectural woodwork for opaque finish.
 - a. Institutional Low-Odor/VOC Latex System: MPI INT 6.3V. (Opaque)
 - 1) Prime Coat: Interior latex-based wood primer.
 - 2) For a Premium Grade system, "MPI Manual" requires intermediate coat; delete intermediate coat for a Custom Grade system.
 - 3) Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - 4) Topcoat: Institutional low-odor/VOC interior latex (semigloss).
 - 2. Architectural woodwork for transparent finish.
 - a. Varnish, Interior, Polyurethane, Satin Finish Over Stain System: MPI INT 6.3E
 - 1) Three Coat System.
 - D. Gypsum Board Plaster Substrates:
 - 1. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (eggshell).
 - E. Gypsum Board Substrates indicated for epoxy paint
 - 1. Water based catalyzed epoxy resin – meet performance requirements of ASTM D3730.
 - a. Prime Coat: as recommended by manufacturer.
 - b. Two component system – semi gloss.
 - c. Low odor/non flammable, low VOC

END OF SECTION

**SECTION 09990
PAINT RESTORATION**

PART 1 - GENERAL

- 1.1 SECTION INCLUDES
- A. Chemical paint removal all salvaged standing and running trim, wainscoting, window jambs and sashes, brackets and similar finish carpentry items that have been previously painted.
 - B. Preparation of surfaces to be painted.
- 1.2 SYSTEM DESCRIPTION
- A. The procedures proposed for the accomplishment of the work shall provide for safe conduct of the work, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, and coordination with other work in progress.
 - B. Submit manufacturer's current printed product description, material safety data sheets (MSDS) and technical data sheets for each product. Include in the work plan a Safety and Health plan describing procedures for handling monitoring, and disposition of VOCs and other hazardous and toxic materials. Submit two (2) copies of the Work Plan and a certificate stating that products proposed for use meet the VOC and hazardous and toxic regulations of the authorities having jurisdiction over the geographical area in which the project is located.
- 1.3 QUALITY ASSURANCE
- A. Worker Exposures
 - 1. Exposure of workers to chemical substrates shall not exceed limits established by the American Conference of Governmental Industrial Hygienists (ACGIH) most current listing.
 - B. Training
 - 1. Inform workers, having access to an affected work area, of the contents of the applicable material data safety sheets (MSDS) and of potential health and safety hazard and protective controls associated with materials used and existing on the project. An affected work area is one which may receive dust, mists, and odors from the surface preparation operations. Workers involved in surface preparation and clean-up shall be trained in the safe handling and application, and the exposure limit, for each material which the worker will use in the project. Instruct personnel having a need to use respirators and masks in the use and maintenance of such equipment.
 - C. Coordination
 - 1. Coordinate work to minimize exposure of building occupants, other Contractor personnel, visitors and general public to mists, odors from surface preparation cleaning and refinishing activities.
 - 2. Protect surrounding materials, landscaping, vehicles and structures from exposure to mists and contamination from surface preparation, cleaning, and refinishing activities.
 - D. Qualifications
 - 1. Provide qualified workers trained and experienced in the preparation for painting of metal surfaces in historic structures having a minimum of five (5) consecutive years of work in this type of work.
 - a. Upon request of Owner submit documentation of 5 consecutive years of work of this type and a statement certified by the Contractor attesting that the experience and qualifications of the workers (journeymen) comply with the specifications.
 - b. Upon request by Owner, provide a list of similar jobs identifying when, where, and for whom the work was done and a current point-of-contact for identified references.
- 1.4 DELIVERY, STORAGE, AND HANDLING
- A. Deliver paints, paint removers, solvents, and other chemicals, in sealed containers that legibly show the designated name, formula or specification number, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name of manufacturer. Furnish such materials in containers not larger than 5 gallons; store them in accordance with the manufacturer's written directions; and, as a minimum, store them off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors and at temperatures between 40 and 95 degrees F.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Unless otherwise recommended by the product manufacturer, the ambient temperature shall be between 45 and 95 degrees F when applying paint removers, solvents, or other preparation materials.

PART 2 - PRODUCTS

2.1 PAINT REMOVERS

Chemical paint removers shall be a commercial item specifically manufactured for the type of paint to be removed.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Use methods for preparation of historic metal surfaces for painting which are the gentlest possible to achieve the desired results. Historic substrate materials shall not be damaged or marred in the process of surface preparations. Collect and analyze samples of the existing paint finishes for the purpose of documentation or matching, at locations shown and as directed by the Architect
- B. Provide three (3) foot square mock-up where directed by Architect demonstrating use of proposed materials and compliance with project requirements.

3.2 PROTECTION OF AREAS NOT TO BE PAINTED

- A. Remove or protect items not to be painted, which are in contact with or adjacent to painted surfaces, prior to surface preparation and painting operations. Replace items removed prior to painting when painting is completed. Following completion of painting, workers skilled in the trades involved shall reinstall removed items. Surfaces contaminated by preparation materials shall be restored to original condition AS DIRECTED BY ARCHITECT AT NO COST TO OWNER.

3.3 CLEANING OF SURFACES

- A. Surfaces to be painted shall be clean and free of grease, dirt, dust and other foreign matter before application of paint or surface treatments. After cleaning, surfaces shall exhibit a surface disfigurement rating of 7 or greater when evaluated in accordance with ASTM D 3274. Dirt and surface contaminants shall be cleaned by hand using brush with solutions of water and detergent or trisodium phosphate, then rinsed clean with water and let dry. Surfaces on which mildew or other microbiological growth is present shall be cleaned with a detergent solution containing household bleach. Oil and grease shall be removed with clean cloths and cleaning solvents. Cleaning solvents shall be of low toxicity with a flashpoint in excess of 100 degrees F. Cleaning shall be programmed so that dust and other contaminants will not fall on newly prepared, newly painted surfaces or adjacent building, site materials or vehicles.

3.4 PAINT REMOVAL

- A. Areas to be stripped: After scraping, removal of large areas of paint or paint on architectural details shall be accomplished using sanders chemical paint removers. Paint shall be removed to bare substrate. Open flame or any form of heat devices shall not be used. Mechanical paint removal shall not be used. Paint removal operations shall not damage or mar the substrate material.
 - 1. Use chemical paint removers in accordance with manufacturer's recommendations. If chemical strippers are used, substrate shall be neutralized after stripping to a pH of 5 to 8.5.
- B. Lead Paint
 - 1. Contractor responsible for all work associated with identification and removal of lead paint. Architect and Owner will provide no further direction on lead paint procedures including but not limited abatement, removal, and disposal.

3.5 TIMING

- A. Surfaces that have been cleaned, pretreated, and otherwise prepared for painting shall be given a coat of the specified first coat as soon as practical after such pretreatment has been completed, but prior to any deterioration of the prepared surface. Unless otherwise directed, the first coat primer shall be applied within 48 hours of surface preparation.

3.6 CLEANING

- A. Place cloths, cotton waste and other debris, that might constitute a fire hazard, in closed metal containers for removal at the end of each day. Containers shall be removed from the site or destroyed in an approved manner. Preparation materials and other deposits on adjacent surfaces shall be removed and the entire job left clean and ready for painting.

END OF SECTION

**SECTION 10520
FIRE EXTINGUISHERS AND CABINETS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fire extinguisher cabinets
- B. Fire extinguishers

1.2 SUBMITTALS

- A. Shop drawings: indicate cabinet physical dimensions, rough-in measurements for recessed cabinets.
- B. Product data: provide extinguisher operational features, color and finish, and anchorage details.

1.3 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Approved product:
 - 1. Larsen's
 - 2. JL Industries
 - 3. Modern Metal Products
 - 4. Architect approved equivalent

2.2 MATERIALS

- A. Fire extinguisher cabinet - semi-recessed:
 - 1. Provide semi-recessed fire extinguisher cabinet of 20 gage steel with white baked enamel finish on interior. Exposed portions of cabinet shall be painted white.
 - 2. Door shall be vertical duo door with DSA glass; door and frame painted white.
 - 3. Rough opening dimensions – 25 inches x 10-1/2 inches x 3 inches deep.
 - 4. Basis of design: Larsen's Model 2409-6R, Vertical Duo-DSA glass (10# extinguisher capacity); semi-recessed, 2-1/2 inches outside exposure.
- B. Surface mounting brackets: painted steel, compatible with fire extinguisher.
- C. Multipurpose Dry Chemical Type: UL-rated 4-A:60-B:C, 10-lb nominal capacity, in enameled steel container, red color, with pressure gage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fire extinguisher cabinets following manufacturer's recommended installation procedures.
- B. Install in locations and at mounting heights indicated or, if not indicated, at heights to comply with applicable regulations of governing authorities.
- C. Prepare recesses in walls for cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.
- D. Fasten mounting brackets and cabinets to structure, square and plumb.
- E. Secure rigidly in place.

END OF SECTION

**SECTION 10801
TOILET ACCESSORIES**

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Washroom accessories.
2. Warm-air dryers.

1.2 SUBMITTALS

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

B. Product Schedule:

1. Identify locations using room designations indicated on Drawings.
2. Identify products using designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 TOILET ACCESSORIES

A. Basis-of-Design Product: The design for accessories is based on Bobrick Washroom Equipment, Inc.'s products unless otherwise indicated.

1. Acceptable manufacturers include:
 - a. American Specialties Inc., Yonkers, NY 914-476-9000
 - b. Bradley, Menomonee Falls, WI 800-272-3539

B. Toilet Tissue (Roll) Dispenser . [TPH]

1. Basis-of-Design Product: Bobrick B-6857
2. Description: Single-roll dispenser .
3. Mounting: Surface mounted.
4. Operation: Noncontrol delivery with theft-resistant spindle .
5. Capacity: Designed for up to 5-12" diameter tissue rolls.
6. Material and Finish: Stainless steel, No. 4 finish (satin) .

C. Grab Bar [GB]:

1. Basis-of-Design Product: Bobrick B-5837
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, No. 4, satin finish.
4. Outside Diameter: 1-1/4 inches.
5. Configuration and Length: As indicated on Drawings .

D. Mirror Unit [M1]:

1. Basis-of-Design Product: Bobrick B-290
2. Frame: Stainless-steel angle, 0.05 inch thick .
 - a. Corners: Manufacturer's standard Welded and ground smooth.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
4. Mirror Glass: No. 1 quality ¼ inch glass mirror electrolytically copper-plated; warranted against silver spoilage for 15 years. Mirror back protected by 3/16 inch thick water resistant polyethylene padding.
5. Size: As indicated on Drawings.

2.2 WARM-AIR DRYERS

A. Warm-Air Dryer [HD]. Basis-of-Design Product: The design is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product acceptable to architect:

1. Basis-of-Design Product: Excel Dryer Corporation, XLERATOR
2. Mounting: Surface mounted.
3. Operation: Electronic-sensor activated with timed power cut-off switch.
4. Cover Material and Finish: Steel, with white enamel finish .
5. Electrical Requirements: 208-240 V, 9-10 Amp, 1900-2300 Watt or as needed for compatibility with electric power provided.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

3.2 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Separate and dispose of waste in accordance with the Project's Waste Management Policy.

END OF SECTION

**SECTION 11451
RESIDENTIAL APPLIANCES**

PART 1 - GENERAL

- 1.1 SUMMARY
- A. Section Includes:
1. Refrigeration appliances.
- 1.2 ACTION SUBMITTALS
- A. Product Data: For each type of product indicated.
- 1.3 INFORMATIONAL SUBMITTALS
- A. Warranties: Sample of special warranties.
- 1.4 CLOSEOUT SUBMITTALS
- A. Operation and maintenance data.
- 1.5 WARRANTY
- A. Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.
1. Warranty Period: one year from date of Substantial Completion.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
1. Amana; a division of Whirlpool Corporation.
 2. Electrolux Home Products (Frigidaire).
 3. General Electric Company (GE).
 4. LG Appliances.
 5. Sears Brands LLC (Kenmore).
- 2.2 REFRIGERATOR/FREEZERS
- A. Refrigerator/Freezer: Two-door refrigerator/freezer with freezer on bottom and complying with AHAM HRF-1.
1. Type: Freestanding.
 2. Storage Capacity (total capacity 22.7 cubic feet):
 - a. Refrigeration Compartment Volume: 16.3 cubic feet.
 - b. Freezer Volume: 6.4 cubic feet.
 3. General Features:
 - a. Interior light in refrigeration compartment.
 - b. Automatic defrost.
 - c. Interior light in freezer compartment.
 4. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
 5. Front Panel(s): Manufacturer's standard Porcelain enamel Stainless steel Wood-panel insert(s) specified in Section 06402 "Interior Architectural Woodwork" to match kitchen cabinets Wood-panel insert(s) specified in Section 12356 "Residential Casework" to match kitchen cabinets Reversible panel(s) with choice of colors Insert description.

PART 3 - EXECUTION

- 3.1 INSTALLATION, GENERAL
- A. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- C. Utilities: Comply with plumbing and electrical requirements.
- 3.2 FIELD QUALITY CONTROL
- A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
 2. Operational Test: After installation, start units to confirm proper operation.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

END OF SECTION

SECTION 12 484
ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL**1.1 SUMMARY**

- A. This Section includes the following:
1. Roll-up mats in recessed frames.

1.2 SUBMITTALS

- A. Product Data: For each type of floor mat and frame.
- B. Shop Drawings: Show the following:
1. Items penetrating floor mats and frames.
 2. Divisions between mat sections.
- C. Samples: For each floor mat and frame member.
- D. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Accessibility Requirements: Provide installed floor mats that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

PART 2 - PRODUCTS**2.1 ENTRANCE MATS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation or a comparable product by one of the following:
1. American Floor Products Company, Inc., Legacy Grate (UX-284), Recessed Aluminum Frame MF-175. (Basis of Design)
 2. American Mat & Rubber Company.
 3. Mats Inc.
- B. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range.

2.2 FABRICATION

- A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.
- B. Recessed Frames: As indicated, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.
1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.
- C. Coat surfaces of aluminum frames that will contact cementitious material with manufacturer's standard protective coating.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. Install recessed mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate top of mat surfaces with bottom of doors that swing across mats to provide clearance between door and mat.
1. Coordinate installation and alignment of frame with specified floor treatment and finish.

3.2 PROTECTION

- A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION

**SECTION 01042
COORDINATION OF UTILITIES**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Coordination of the following for all areas:
 - 1. Ductwork
 - 2. Plumbing
 - 3. Piping
 - 4. Mechanical and electrical equipment
- B. Section 01042 covers coordination of utilities in all areas.

1.2. QUALITY ASSURANCE

- A. Utility installation in congested areas is dependant on the sequence of utility installation as much as it is dependent on the physical size of the utilities. The Contractor shall use the coordination process to properly sequence as appropriate, to ensure the above ceiling and congested utility installation is satisfactory.

1.3. SEQUENCE

- A. Complete the utility coordination process for areas not specified to have coordination drawings prior to submitting submittals for items included in the coordination area.

1.4. ORDER OF PRECEDENCE OF EQUIPMENT AND ITEMS

- A. The list below is the precedence of assigned work items for space priority in descending order. Items not listed shall have the same precedence as similar items.
 - 1. Reflected ceiling with all light fixtures, access above light fixtures required for maintenance and all ceiling fixtures and devices, and facility equipment.
 - 2. Spaces designed for future utility placement and equipment access for maintenance.
 - 3. Gravity flow plumbing, waste, and coil condensate drains.
 - 4. Heat pump equipment and electrical equipment.
 - 5. Ductwork and appurtenances except that external bracing shall be relocated to accommodate local interferences.
 - 6. Electrical conduit that shall be provided under this contract.
 - 7. HVAC piping (except for gravity flow condensate), potable water.
 - 8. Plumbing vents that are indicated.

1.5. PARTICIPATION

- 1. The Contractor and subcontractors responsible for items of work located in or above ceilings shall participate in the coordination of the utilities. Participation is mandatory. If the Contractor or subcontractor fails to participate in the coordination process, the Owner reserves the right to do the following:
- 2. Require the relocation and resizing of components as necessary to ensure components will be installed as intended. In the event the Contractor did not participate in the coordination process, the Contractor will not be entitled to contract cost increases or time extensions due to Owner initiated changes in the work.
- 3. The Contractor shall be held responsible for unnecessary rework that is attributable to failure to participate in the coordination process.

PART 2. PRODUCTS Not used

PART 3. EXECUTION

3.1. GENERAL

- A. Provide coordination in determining adequate clearance and space requirements for mechanical equipment and other items/equipment in the project. The Design Professional reserves the right to determine space priority of equipment in the event of interference between pieces of equipment, piping, conduit, ducts and equipment of the trades. The Design Professional will only review conflicts and give an opinion, but will not perform as a coordinator.
- B. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility or component because of the scale of the drawings and

possible variations in specific equipment. Each contractor is expected to have included in his bid sufficient fittings, material and labor to allow for adjustments in routing of utilities made necessary by the coordination process. The Contractor will not be allowed any contract cost extra or time extension for participating in the coordination process or for location of utilities dictated by the coordination process to permit the installation of all utilities, and equipment, and to provide equipment access.

- C. Deviations from the Contract Documents that are necessary for the overall system installation and coordination shall be brought to the attention of the Design Professional. Such necessary changes in the **Contract** scope discovered throughout the coordination process will be covered by the requirements of the Section of the specifications covering "changes in Work".
- D. Access panels shall occur only in gypsum wallboard, wood finished surfaces, or plaster ceilings where indicated on the drawings. Access to mechanical and electrical items shall be through accessible acoustical ceiling areas. Additional access panels will not be allowed without written approval from the Design Professional at the coordination stage and only after alternatives are reviewed. Layout changes shall be made to avoid additional access panels. If additional access panels are required, they shall be provided at no additional cost to the Owner.
- E. Soffit penetrations and light alcoves shall be fully coordinated with hanging devices, studs, fire/smoke ratings and structural support requirements.

3.2. PROCEDURE

- A. Initial coordination:
 - 1. Prior to start of construction, a meeting shall be scheduled with participants responsible for the coordination of the work. Utility coordination requirements shall be implemented in relation to the project progress schedule.
- B. Coordination Meetings:
 - 1. A meeting shall be scheduled with the coordination participants to resolve all areas of conflict determined by the participating subcontractor.
 - a. Meeting participants shall overlay the transparency drawings to identify areas of conflict, cooperate in resolving the conflicts.
 - b. The coordination participants shall recommend changes, rerouting, resizing or relocation of components, if necessary, so all trades can install their systems in the space allotted.
 - c. Any proposed changes from the systems layout on the construction documents, shall be done in accordance with the design criteria specified in applicable codes and standards outlined in each technical section.
 - d. Changes shall be subject to the review and acceptance of the Design Professional.
 - e. The coordination process shall be repeated until all the designated areas of the Work have been coordinated.
 - 2. Coordination participants shall provide equipment installation and clearance requirements.
- C. The Contractor shall indicate which Contractors participated in the process and where conflicts appear to occur even after the priority ranking of utility routing has been utilized. In the event that conflicts require input from the Design Professional, solutions will be provided for review by the Design Professional, the Design Professional will review and return with their opinion to the contractors for implementation.
- D. When a change order request is issued, the affected subcontractors shall bring to the attention of the Contractor and the Design Professional revisions necessary to the work of others not directly affected by the change order.
- E. Coordination participants that fail to cooperate in the coordination effort shall be responsible for all costs incurred for adjustments to the work made necessary to accommodate installations. Provide adequate clearance and access through accessible ceilings.

END OF SECTION 01042

**SECTION 15010
MECHANICAL GENERAL PROVISIONS**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Provide all materials and labor and all equipment to make complete operating mechanical systems. Place all such equipment in initial operation, make all initial tests to ensure compliance with specifications and their intent, obtain approval in writing from all governing bodies having jurisdiction over this work, and the utility companies providing utilities to the project to ensure compliance with all laws, ordinances and standards in effect.
 - 1. The project HVAC mechanical work shall be the sole responsibility of a single Mechanical Contractor.
 - 2. The Contractor providing the Mechanical work specified in Division 15 shall be referred to as the Division 15 Subcontractor or the Mechanical Contractor throughout the specifications.
 - 3. The Contractor responsible for performing control system work specified in Section 15950 shall be referred to as the Control Subcontractor in the Specification.
 - 4. The Contractor performing the test and balance work specified in Section 15990 shall be referred to as the Testing and Balancing Subcontractor or the Balancer.
 - 5. The Contractor providing the electrical work shall be referred to the Electrical Contractor throughout the Specification.
 - 6. The Geothermal Loop Field specified in Section 15031 shall be provided by the Division 15 Contractor. The Contractor shall coordinate installation, start up and testing of the HVAC with the loop field Subcontractor.
 - 7. The system balancing specified in Section 15990 shall be under this Mechanical contract and shall include balancing of the Geothermal Loop Field as specified in Section 15031.
- B. Install all equipment in accordance with the equipment manufacturer requirements and/or recommendations.
- C. The Division 15 Contractor shall provide utility hook ups and final connections to equipment specified in other specification Divisions to have mechanical utilities. The Division 15 Contractor shall perform the pressure and leak integrity tests as specified in these Sections. Refer to the Division 15 Work Package description and to the following sections for additional requirements:
- D. Participate with the Testing and Balancing Contractor, the Control System installation personnel and the Design Professional in the overall set up and check out of the mechanical systems. This set up and check out effort shall include the adjustment of mechanical system components as necessary for the different systems to function together as intended and participation in the demonstration and "shakedown" operations necessary to "debug" the mechanical system operation. This effort shall be in addition to any system demonstrations specified to be provided by the Contractor to the Owner's personnel.
- E. Drawings are diagrammatic, intended to convey the scope of the Work and to indicate the general arrangement and locations of the Work. Because of the scale of the Drawings, certain basic items such as pipe fittings, access panels, and sleeves may not be indicated. Where such items are required by Code or by other Sections, or where required for proper installation of the Work, provide such items.
- F. Equipment Specifications may not deal individually with minute items required such as components, parts, controls and devices which may be required to produce the equipment performance specified or as required to meet the equipment warranties. Provide such items where required whether or not specifically identified.
- G. Provide the site utilities including materials, trenching, boring, drilling, grouting, backfilling and utility company coordination as follows:

1. The Mechanical Contractor shall provide the "Geothermal Loop Field Heat Exchanger" for the building heat pump HVAC systems. Provide building piping, valving and control interfaces specified in Section 15031 that are required inside the building.
2. Provide the site sanitary sewer connections from the building's edge to site sanitary sewer system at point as indicated on plans to a point approximately 5'-0 inches beyond the building wall.
3. Provide domestic main to inside building domestic water systems from a point 5'-0 inches beyond the building wall.
4. Site sanitary sewer and potable water will be provided under separate sections.

1.2. MEASUREMENTS

- A. All measurements must be verified from actual observations at the project site. The Contractor is responsible for all his work fitting into place in approved, satisfactory, and workmanlike manner in every particular.

1.3. DRAWINGS AND SPECIFICATIONS

- A. General character and scope of work are illustrated on Drawings and/or listed in Specifications. Drawings and Specifications are complementary one to the other; whatever is called for by one shall be as binding as if called for by both.

1.4. LAWS, PERMITS AND REGULATIONS

- A. Obtain and pay for all licenses and permits, pay all fees and/or charges for meters and associated devices, pay all charges for connection to outside services. Comply with all laws, ordinances, regulations and code requirements applicable to his work. It is assumed that the Contractor is familiar with all laws, codes and ordinances governing his work and that all work done by him will be approved by authorities having jurisdiction over his work, in Adair County, Iowa and Stuart, Iowa.
- B. All work shall be performed in compliance with all applicable Laws, Codes and Regulation of the governmental Bodies having jurisdiction over the site.
- C. Work not regulated by Governmental Bodies shall be performed in accordance with current issues of the following Codes and Standards, unless indicated otherwise by the Authority having Jurisdiction.
 1. Air Moving and Control Association, Inc. - AMCA.
 2. American National Standards Institute - ANSI.
 3. American Society of Mechanical Engineers - ASME
 4. American Society for Testing and Materials - ASTM.
 5. American Water Works Association - AWWA.
 6. Manufacturers Standardization Society of the Valve and Fittings Industry - MSS.
 7. National Electrical Manufacturers Association - NEMA.
 8. National Electrical Code - NEC.
 9. National Fire Protection Association - NFPA.
 10. Sheet Metal and Air Conditioning Contractors National Association - SMACNA.
 11. Underwriters' Laboratories - UL.
 12. Local and State Building Codes; Plumbing, Mechanical, etc.
 13. American Society of Heating, Refrigerating and Air Conditioning Engineers - ASHRAE.
 14. International Mechanical Code - 2009
 15. Uniform Plumbing Code – 2009.
 16. International Energy Conservation Code, 2009
 17. International Fire Code – 2009
 18. International Building Code, 2009
 19. International Ground Source Heat Pump Association (IGSHPA)
 - a. Closed-loop/Geothermal Heat Pump Systems - Design and Installation Standards.
 - b. Grouting for Vertical Geothermal Heat Pump Systems - Engineering Design and Field Procedures Manual.
 - c. Closed-Loop/Geothermal Source Heat Pump Systems - Installation Guide.
 - d. Grouting Procedures for Ground-source Heat Pump Systems.

- D. The Contractor shall have copies of all MSDS sheets for hazardous items used for construction at the job site and shall train personnel in the use of these substances.
- E. The Division 15 systems shall comply with requirements of the following utility companies providing various utilities for the project.
 - 1. Stuart Electric
 - 2. Stuart – Director of Public Works Water Department, Potable Service.
 - 3. Stuart Sewer Department

1.5. TESTS AND INSPECTIONS

- A. Final settlement will not be made with the Division 15 Contractor until the mechanical systems have been thoroughly checked and found in good operating condition as determined by the Design Professional and the Testing and Balancing Contractor. All materials and workmanship shall be subject to inspection, examination, and test by Design Professional's Representative at any and all times.

1.6. COOPERATION AND PROGRESS

- A. Keep informed about the work of all other trades engaged in the project and execute the work in such a manner as not to delay or interfere with the progress of other contractors. This Contractor shall schedule his work so that no other contractor is delayed in the execution of his work. Complete cooperation of all trades is expected. Employ a competent foreman on job throughout the entire project to ensure that coordination is maintained.
- B. Schedule and coordinate the work of this Division with the schedule of the Contractor to progress the work expeditiously, and to avoid unnecessary delays.
- C. Utility installation in congested areas is dependent on the sequence of utility installation as much as it is dependent on the physical size of the utilities. The contractor shall use the coordination process to properly sequence the installation of utilities as appropriate to ensure the above ceiling and congested area utility installation is satisfactory and that the specified maintenance access space to above ceiling equipment is provided. Division 15 Contractor and subcontractors shall participate in the coordination process specified under Section 01042.

1.7. PROTECTION OF WORK

- A. Protect the work from damage or injury by keeping all pipes and waste lines plugged, capped, drained, and all equipment covered or otherwise protected. Damaged material or equipment shall be replaced or repaired without cost to the Owner. All pieces of equipment shall be given suitable protection from injury or damage and upon completion of project shall be equal to new condition.
- B. Do not route piping above any electrical equipment unless the piping serves that equipment. When piping is required to be installed in electrical rooms or directly above electrical equipment, provide a corrosion resistant drain pan to protect the electrical equipment.
- C. Refer to Section entitled "Special Procedures for Historic Preservation" for protection requirements for historically significant items.

1.8. SLEEVES AND CHASES

- A. All pipes that pass through nonrated walls shall have pipe sleeves 1 inches larger than pipe and pipe covering if covered. Where pipes pass through floors, sleeves 1/2 inches larger than pipe installed of sufficient length to extend 3 inches above floor line. Sleeves shall be Schedule 40 galvanized pipe. Sleeves shall be perfectly plumb and pipe placed concentrically within sleeve; sleeves shall be set during construction. If specifically approved by Design Professional, sleeves may be set later using carbide tipped hole saws and approved methods of cutting. All penetrations through floors shall be sealed watertight.
- B. Sleeves in exterior walls shall be provided with approved waterproofing. Floor sleeves shall be sealed with Permagem or Design Professional approved equivalent. Piping requiring chases in a wall shall be reported to the Contractor and located so that they can be provided.

- C. Non-permanent pipe sleeves may be plastic to facilitate removal from concrete prior to pipe installation. Verify locations of acceptable use by obtaining approval from Design Professional.
 - D. All piping and sleeves passing through all nonrated and exterior walls shall be packed in space between piping and sleeve with insulation for full length of sleeve. Calk sleeve air tight at both ends.
 - E. All piping and ductwork passing through fire-rated and/or smoke-rated walls, ceilings and floors shall conform to UL standards and be installed as shown in UL listed details. For piping passing through fire-resistive assemblies, sleeves shall extend the length in both directions from structure as detailed in the applicable UL assembly detail. The piping penetration shall have the equivalent fire resistive rating as the UL assembly indicated.
 - F. Sleeves for insulated piping: of sufficient internal diameter to take pipe and insulation and to allow for free movement of pipe.
 - G. Waterproof sleeves: of sufficient internal diameter to take pipe and waterproofing material.
 - H. In finished areas where pipes are exposed, terminate sleeves flush with wall, partitions and ceilings, and extend 1/2 inch above finished floors. Extend sleeves 3 inches above finished floors in areas likely to entrap water.
 - I. Pipe to wall penetration closures for underground pipe penetrations:
 - 1. Linkseal by Thunderline Corp.
 - 2. Calpico Pipe Lerax by Calpico, Inc.
 - 3. Flexicraft Seals
 - 4. Metraflex Seals
 - 5. All wall or floor pipe penetrations that are underground shall be sealed to prevent water entry.
 - J. The Division 15 Contractor shall not cut openings in the roof, exterior walls or any other load bearing wall structures of the existing building. Such openings will be made and sealed by the General Works Contractor. The Division 15 Contractor shall give specific locations, shapes and sizes for each penetration in the building exterior walls, roof or load bearing walls so the openings can be provided by the General Works Contractor. The Division 15 Contractor shall not rely solely on the penetration shown on the Mechanical Construction Drawings for this information. Rather, the Division 15 Contractor shall use the actual field layout locations of all penetrations that reflect dimensional shop drawing information, coordination with other work categories and the Contract Drawings to provide penetration information to the General Works Contractor. Refer to the Division 15 details on the drawings for more specific penetration reinforcement details.
 - K. Sleeves and frames at floors and walls in concealed locations and in unfinished spaces such as mechanical rooms, etc. shall extend 1 inches from finished surface. All other sleeves at floor shall extend 1/4 inches from finished floor surface, but shall allow placement of escutcheons. All other sleeves at walls shall be installed flush with finished surface.
 - L. Penetrations through exterior walls or roof structure that open to the interior of the facility shall be "screened" and sealed to prevent pest entry into the building.
 - M. Piping and duct penetrations through masonry and concrete walls shall be reinforced by lintels on both sides of the penetration through the wall or vertical structure. The lintels shall support and transfer weight of the material above the opening to the wall material on each side of the opening. The wall penetration reinforcing shall be as indicated on the details included with the drawings.
- 1.9. SITE SERVICES AND UTILITIES
- A. Site utilities of geothermal loop field and geothermal mains to the point indicated on the plan shall be provided by this Mechanical Contract.
 - B. The site active utilities have been located as accurately as possible, however, the exact location is not guaranteed. Contractor must personally inspect such conditions and determine such locations or coordinate the placement of these site utilities with the site utility installing contractor. Variations from locations indicated will not be basis for additional compensation or contract time extensions.

- C. The Mechanical Contractor shall provide the geothermal/loop field heat exchanger and main geothermal piping up to the header end and the header inside of the building.
 - D. The Division 15 Contractor shall provide all necessary "de-watering" required for any underground work. There may be a "high water table" level at the construction site. The Contractor will not be entitled to any contract time extension or contract extra for any de-watering required to install his work.
 - E. The geothermal loop field and distribution piping shall be connected to inside of the building. The Division 15 shall interface with the Loop Field Subcontractor, Section 15031, in locating the inside/outside isolation valves in the mechanical equipment rooms.
- 1.10. IDENTIFICATION
- A. Every mechanical device, piece of equipment, starter, control panel, furnished by the Contractor which does not have an identifying name plate shall be stenciled to identify its use, exact identification words to be verified on jobsite. Labels shall be located as approved by Design Professional. Labels shall be 1-1/2 inches x 3 inches, 18 gage brass tags with approved printing may be riveted or screwed to equipment.
- 1.11. ELECTRICAL WORK
- A. In general, the Electrical Contractor will carry service to disconnect and extend wiring to motor starter and then to motor. Wiring over and above this, unless specifically indicated on electrical plans, shall be by Contractor furnishing equipment.
 - B. Any electrical work done by the Division 15 Contractor shall be done in accordance with Division 16 requirements.
 - C. The Division 15 Contractor shall provide equipment internal alarm wiring, control wiring or interlock wiring for equipment furnished by the Contractor. The Division 15 Contractor shall provide control system components and wiring specified in Section 15950. Electrical materials and installation for equipment and materials installed by the Division 15 Contractor shall meet the requirements of NEC and other code requirements.
 - D. Provide motors, motor starters and contactors for specific equipment specified in Division 15 sections.
 - E. Coordinate motors and mechanical equipment which require electrical services with requirements of the electrical construction.
 - F. Where motors or equipment furnished require larger services or services of different characteristics or configurations than those indicated, provide material and services to fit the motors or equipment furnished.
- 1.12. SUBMITTALS
- A. Refer to Division 1 for general submittal requirements.
 - B. Coordinated shop drawings shall be provided on all equipment specified in Division 15 and shall be in accordance with the applicable sections and general provisions of this specification. Additionally, all shop drawings submitted pertaining to major equipment items shall include the particular item(s) intended for installation drawn on minimum 1/4 inches scale blue-line backgrounds or reproducible mylars indicating sufficient information to ensure compatibility with physical constraints, manufacturer required maintenance and code clearances, and indication of non-interference with work installed by other trades and other work installed by this trade.
 - C. Substitute Items:
 - 1. Following contract award, modified structural, Architectural, mechanical, and electrical work or redesign required as a result of the Division 15 Contractor implementing an approved Alternate, or providing substitute or "approved equal" materials and equipment shall be at no additional cost to the Owner.
 - 2. Substitute items will be allowed only under the conditions specified in the General Conditions and Division 1 of the specifications.
 - D. The Contractor shall not install or fabricate any items without receiving accepted shop drawings from the Design Professional for those sections requiring submittals.
 - E. Both Division 15 and Division 16 contractors shall provide written certifications that the electrical services to the mechanical equipment are totally compatible with the

mechanical equipment being provided. Certification shall be submitted to the Owner's Representative and the Design Professional prior to energizing the equipment.

- F. The Division 15 Contractor shall submit evidence of having transmitted accepted equipment shop drawings to the Division 16 Contractor for use in coordinating the mechanical and electrical system interfaces. The evidence shall be submitted to the Design Professional and the Owner's Representative for review.

1.13. OPERATION AND MAINTENANCE MANUALS

- A. Provide operating and maintenance manuals as required by individual sections.
- B. Instructions in Operation.
 - 1. After all tests and adjustments have been made and the maintenance manual has been completed and given to Owner, furnish one or more full-time qualified personnel as necessary to put mechanical Work in continuous operation for a period of not less than one day, 8 hours, during which time the designated personnel's only purpose shall be to give complete operating and maintenance instructions to the operating personnel selected by Owner, and furnish all service necessary for the proper operation and protection of mechanical Work. Fuel, power, and other supplies required during this period will be furnished by Owner.
 - 2. Operational instruction training shall be mutually exclusive of any control system training which may be specified under Section 15950.

1.14. USE OF NEW EQUIPMENT DURING CONSTRUCTION

- A. All work shall be kept clean and free of debris as construction progresses. Material finishes shall be protected by covers to prevent impingement of corrosive and abrasive elements. Exterior finish damage shall be repaired to original condition.
- B. All ductwork sections shall be kept clean and free of debris and dust as construction progresses. Individual lengths of ductwork shall have ends capped to prevent the entrance of construction dust, dirt, water and other debris while being stored on site. The interior surfaces of all supply and return air ducts shall be wiped clean prior to being installed into the duct system. All duct system openings in unfinished duct systems shall be taped shut or wrapped in plastic to maintain the interior surface cleanliness during the construction period.
- C. The HVAC systems shall not be used to ventilate, heat or cool any areas under construction or during periods of interior finishing such as gypsum board sanding. However, the building HVAC may be used for construction period HVAC under the following conditions if it can be demonstrated there is no other practical way to provide the needed construction period HVAC.
 - 1. The Contractor shall request written permission from the Owner's Representative and the Design Professional to use the HVAC systems for such purposes. The request shall explain fully what other methods were considered and why they can not be used. If the Owner grants written permission to use the permanent HVAC systems for providing construction period ventilation, the following requirements shall apply:
 - a. The system operation shall be set up so the maximum air feasible from the space is exhausted. Filters shall be provided at each return inlet.
 - b. Filter modules identical in efficiency and quality to that specified for the permanent system shall be installed in the heat pumps and the heat recovery units. Such filters shall be changed as the modules load up with dust and dirt. The pressure drop for these construction period filters shall not be allowed to exceed what is specified for the maximum pressure drop for the permanent filters. The Contractor shall install temporary filter pressure gauges across the filter banks if the permanent pressure indicators are not available to indicate the filter pressure drop.
 - c. The air balancing of the air delivery systems shall not occur whenever there is system finishing such as gypsum board sanding occurring.
 - d. Prior to substantial completion, all internal surfaces of the heat pumps, make up air handling units and heat recovery units shall be wiped clean and the coils shall be steam cleaned.

- e. Precautions shall be taken to keep control elements such as duct probes protected from dust or vapor damage. If these devices cannot be adequately protected during the construction ventilation process, they shall be removed from the duct system and re-inserted after the construction period ventilation process is finished.
 - f. Each heat pump and heat recovery unit shall be run continuously for 24 hours after the system air balance and all construction have been completed to "flush" all dirt from the duct system. After the 24 hour run period the filter modules shall be replaced with clean media of the permanent filters, or clean "cleanable" filters.
 - g. **Heat pump systems shall not be used until all hydronic testing, pipe cleaning, balancing, and filling are satisfactorily completed as specified.**
- D. The Contractor shall use an independent duct and equipment cleaning contractor to clean the equipment specified. The Contractor shall coordinate the work of the test and balance contractor and the equipment cleaning contractor to ensure the satisfactory cleaning and commissioning of the air delivery systems. The preferred sequence is for the duct and equipment cleaning to occur after the balancing has been completed, however, some cleaning operations such as steam cleaning fans may be detrimental to the balancing operation because water may get inside the air foil fan blades. The balancing and cleaning contractors shall certify that the cleaning operations undertaken will not be detrimental to the balancing.
- E. The Contractor shall have an independent duct cleaning company clean all new return and supply ducts, and any other new ductwork that serves the project area as indicated on the drawings so the ductwork is placed in a "clean" condition (dust free clean duct) in accordance with the standards and test methods of the National Association of Duct Cleaning Contractors. Temporary duct need not be cleaned. Refer to the drawings for additional requirements for ductwork cleaning. The Contractor shall access the duct for cleaning through removable ceiling tiles and access openings as required, in the ductwork as needed to clean the duct. The Contractor shall provide access panels to cover any openings he makes in the new and existing ductwork for cleaning purposes. The access panels shall be located as required to perform the duct cleaning. Access panels that are provided for other uses may be used for this function. The access panels shall be in accordance with duct construction accessory requirements specified in Section 15890. The Contractor shall use an independent ductwork and equipment cleaning contractor to clean the duct and equipment specified.
- F. The Contractor and duct cleaning company shall submit a certification of cleaning attesting that the ductwork specified has been cleaned as specified.
- G. The Owner will have the ductwork specified to be cleaned inspected by an independent inspector for cleanliness. It will be this inspector's sole responsibility for determining if a section of ductwork or piece of equipment has been cleaned. If the ductwork is found not to be cleaned, the Contractor shall have the "dirty" portion of the duct re-cleaned by the duct cleaning company. The re-cleaned portion will be re-inspected for cleanliness by the Owner's independent inspector.
- H. Install permanent filters in the units, or clean "cleanable" filters and in the ductwork, only after the systems have been cleaned as specified and all construction period "flush out" operations have been completed. Replace construction period filters with "new" permanent filter modules or clean "cleanable" filters. Provide one complete "extra" set of filters to the Owner prior to final acceptance of project.
- I. The supply and return ductwork system, heat pumps and heat recovery units shall be turned over to the Owner in a "clean" condition. The "clean" condition is defined as a "dust free clean duct system" in accordance with the standards and test methods of the National Association of Duct Cleaning Contractors. The Design Professional shall be the sole judge of the "clean condition" of the supply duct system. This Contractor shall be

solely responsible for cleaning the supply air after it is in place if it does not meet the specified "clean" condition.

- J. It is understood that the Division 15 Contractor must start the HVAC systems during the construction period to check system operation, set control system set points, balance air and water systems and trouble shoot any system "problems." This operation is required to get the mechanical systems operational for substantial completion and for final completion. The Contractor does not need the Owner's approval to start HVAC systems during the construction period for these purposes. The duct cleanliness requirements and filter requirements, and limits on start up of units specified shall apply for the start up work.

1.15. OPENINGS, CUTTING AND PATCHING

- A. Refer to Architectural drawings and specification for cutting and patching requirements for structural and architectural components.
- B. The Division 15 Contractor shall be responsible for cutting and patching openings in new interior walls, floors or ceilings for piping, duct and control penetrations in these structures. Patching shall match adjacent materials and surfaces and shall be performed by craftsmen skilled in the respective craft required. The Division 15 Contractor shall not cut openings in pre-cast structures, exterior walls or the roof structure.

1.16. CONCRETE WORK

- A. Concrete equipment bases and equipment pads for all floor mounted equipment shall be provided.

1.17. ACCESS DOORS

- A. Provide access doors or access panels where required for access to components and equipment whether or not such access openings are indicated on the drawings.
- B. Access doors or panels through structures shall be a minimum size of 24 inches x 24 inches unless the Contractor gets specific permission from the Design Professional to change. Locations in all structures shall be approved by the Design Professional.
- C. Access panels and doors in ductwork shall be in accordance with SMACNA details and shall be at least square and the smallest dimension shall be outside duct dimension minus two inches.

1.18. ESCUTCHEONS

- A. Provide chrome plated escutcheons at each sleeved opening into finished spaces. Fit escutcheons around insulation or around pipe when not insulated; outside diameter to cover sleeve. Where sleeve extends above finished floor, escutcheon shall be high cap type and shall clear sleeve extension. Secure escutcheons or plates to sleeve but not to insulation with set screws or other approved devices.

1.19. ANCHORING OF EQUIPMENT

- A. Secure equipment located on floor slab or bases, that is not mounted on wheels and is capable of being moved to the floor with anchor bolts. A minimum of two bolts but generally four or more, are required per each piece of equipment. Provide bolts of sufficient size to prevent equipment from overturning.
- B. Refer to drawings for "wood" escutcheons for pipe riser exposed to view.

1.20. PAINTING OF MECHANICAL WORK

- A. Painting of mechanical components shall be under the Painting Section, not under Division 15. The general works contractor shall paint exposed to view mechanical system components.
- B. The Division 15 Contractor shall be responsible for touch up painting and repair of surfaces that are specified to be factory finished. Such surfaces include, but are not limited to, the heat pumps, diffusers, fin tubes and radiant heating panels.

1.21. ENVIRONMENTAL CLASSIFICATIONS

- A. Refer to NEC for environmental locations. Locations shall be outside or inside, dry unless specified indicated otherwise.
- B. Electrical and electronic control components and wiring furnished by the Division 15 Contractor shall be suitable for use in the environment as indicated.

1.22. MECHANICAL CONTRACTOR INTERFACE WITH AUTOMATIC CONTROL

- A. Refer to Section 15950 "Controls" for the description of the automatic controls to be provided.
- B. The Mechanical Contractor shall be responsible for installing the following items in mechanical system:
 - 1. Install Control Contractor provided automatic control dampers in ductwork.
 - 2. Install Control Contractor provided automatic control valves in water piping systems.
 - 3. Install thermal wells and pressure taps in piping systems for Controls Contractor provided sensors and instruments.
 - 4. Install duct access panels for duct mounted controls and instruments provided by the Controls Contractor.
 - 5. Provide necessary blank off plates for Control Contractor provided control dampers.
 - 6. Control Contractor - provide control system interfaces specified in Sections 15434, 15865, 15850, 15782, 15815, 15830, and 15835.

1.23. MODEL NUMBERS

- A. Model numbers are used in some instances to help define the overall characteristics required of a specific component, however, it is recognized that model numbers change from time to time or that the model numbers listed may be incorrect. The Contractor shall provide the components that satisfy the performance requirements specified, rather than providing units meeting the model number requirements in the event there is a discrepancy. The geothermal/closed loop heat pump system design was based upon using the heat pump manufacturer and model numbers specified on the drawings. It is recognized that the loop field design may change slightly depending upon the components actually provided. The Division 15 Contractor shall make the modifications required to coordinate the loop field design with the HVAC system provided. Submittals on the HVAC system and the loop field shall reflect this coordination.
- B. The Contractor shall not rely on the model numbers for selecting the appropriate components to be furnished.

1.24. ACCESS TO EQUIPMENT.

- A. All motors, valves, control devices, equipment, specialties, etc. shall be located for easy access for operation, repair and maintenance. If items are concealed, provide access doors of size required for easy access to the items. (Refer to paragraph 15010.1.17, Access Doors for minimum size a access opening.) Doors and panels furnished by this Contractor will be installed by other trades. Not all required access doors and panels are shown. The Division 15 Contractor shall be responsible for proper coordination with the General Works Contractor in locating access doors and panels for ease of operation and maintenance of concealed equipment, valves, and other devices.
- B. Access to above ceiling heat pump units shall be coordinated with Acoustical Ceiling Contractor and drywall contractor so removable sections are provided at the heat pumps located above ceilings.

1.25. ROOF AND OTHER VAPOR BARRIER PENETRATIONS.

- A. All roof and other vapor barrier penetrations associated with Division 15. On project Work, this Contractor shall be responsible to provide the dimensions and locations of all sleeves, pre-fabricated frames, and openings to the Roofing Contractor.
- B. Provide pipe penetration roof and other vapor barrier penetrations seals consisting of suitable flashing bases and caps of a manufactured system compatible with the roof system encountered at each penetration location. Provide roof penetration seal system products of EPDM, neoprene, hypalon, laminated acrylic-coated ABS, or aluminum as applicable. Roof seals and wall penetration seals shall be compatible with the new building roof vapor barrier and insulation.
- C. Pitch pockets are not acceptable.

1.26. INSTALLATION

- A. Installation:
 - 1. General.

- a. Cooperate with all other Contractors in furnishing material and information for correct location, in proper sequence, of all sleeves, bucks, inserts, foundations, wiring, etc.
- b. All piping connections to equipment shall be made with unions or flanges to permit dismantling. Flanges and unions shall also be installed in the piping systems to permit disassembly consistent with good installation practice and as required for removal of connected equipment from place of installation.
2. All belt drives, flexible couplings, and other exposed rotating or reciprocating parts shall be covered with OSHA approved safety covers. Covers shall be permanent type and easily removable. Guards shall be the standard product of the equipment, unit, or fan provided or shall be constructed as shown in accordance with the SMACNA-HVAC Duct Construction Manual. Guards shall have tachometer access holes at the driven machine's shaft centerline. Coupling guards shall completely cover the coupling and other moving parts.
3. All motors and bearings shall be covered with watertight and dustproof covers during construction period.
4. Interference: Wherever piping runs on or above ceilings, arrange the run of piping in such a manner that it does not interfere with grilles, light outlets or light fixtures. Piping specified to be exposed to view shall be run parallel or perpendicular to walls, unless specifically indicated otherwise on the Contract Drawings.
5. Valves: Valves shall be provided on all piping wherever shown or specified using adapters where required. All removable or replaceable equipment shall be valved. All valves shall have a securely fastened stamped brass metal plate each bearing a different number identified in the operating and maintenance manuals.
6. Openings in Pipes: All openings in pipes shall be kept closed during progress of the Work.
7. Lubrication: Provide all lubrication for operation of all equipment requiring lubrication until substantial completion of Project. Run in all bearings. After oil-lubricated bearings are run in, drain and flush bearings and refill with a new oil change. After repackable grease-lubricated bearings are run in, repack with fresh grease of the type recommended by the bearing/equipment manufacturer. Refer to operating and maintenance manual specification for lubrication chart.
8. Freeze Protection: It shall be the responsibility of the Contractor during the warranty period to perform, in cooperation with Owner's personnel, all operations necessary to protect cooling system for winter freeze protection, including but not limited to, draining hot water coils.
9. Refrigerant & Oil.
 - a. Provide complete and working charge of proper refrigerant, free of contaminants, into each refrigeration system. After each system has been in operation long enough to insure completely balanced conditions, check the charge and modify it for proper operation as required.
 - b. Provide a complete charge of special oil for refrigeration use suitable for operation with the refrigerant in each compressor.
10. Welding Precautions/Piping Protection: Contractor shall not, under any conditions, utilize the installed (existing or new) pressurized piping system(s) for a grounding electrode for any arc welding machines. [Such practice can cause electrolytic/galvanic action which can generate scale which degrades the internal piping walls, resulting in pipe system fouling and holidays.]
11. Protection Of The Owner's Personnel or Other Third Parties: If the Contractor must operate any potentially dangerous devices before all specified safety valves, controls or other safety devices are installed, he shall operate the device only under the supervision of qualified operator and he shall provide advance notification to the Owner where there is potential of Owner's personnel or other third party access to the proximity of the systems and/or equipment to be placed under operation or test.

1.27. ADJUSTMENT AND CLEANING

- A. Safety Devices. Thoroughly check all safety devices to assure proper operation and protection.
- B. Service.
 - 1. Perform service on all mechanical Work until date of substantial completion including oiling, and greasing, adjustments, cleaning, packing of seals, and other items as recommended by equipment manufacturer in the maintenance manual hereinbefore specified.
 - 2. Air filters.
 - a. Do not operate air moving equipment having air filters unless temporary filters are in place to protect mechanical Work. Temporary filters shall have identified efficiencies to that specified for the permanent filters.
 - b. Clean or replace these temporary filters before final test and balance Work is begun as necessary for accurate readings. After completing the testing and balancing Work, replace temporary filters with new filter media at the efficiencies specified.
 - 3. Strainers.
 - a. Remove, clean and reinstall each strainer screen as specified below after systems have been flushed as specified in Section 15060, PIPE AND PIPE FITTINGS.
 - (1) Clean each strainer after all adjustments have been made and system has operated a minimum of 24 hours, but before final test and balancing operation is started.
 - (2) Clean each strainer again, after final test and balancing operation and before substantial completion of the Project.
 - b. Certain screens may remain out of the strainer body after removal during final cleaning only as directed by the Design Professional.
 - 4. Purge all air from water systems after each servicing.
 - a. Protect all furnishings and finishes during each servicing operation, and repair or replace to original condition, those damaged as a result of servicing.
 - 5. Replace insulation removed or damaged after each operation. Leave insulation as specified in Section 15250, MECHANICAL INSULATION.
 - 6. Contractor may coordinate servicing operations with instructing Owners operating personnel so as to coincide with time interval specified for instruction in operation.
 - 7. Put mechanical system in full operating condition before substantial completion of Project.
- C. Alarms: Test and adjust all alarms for satisfactory operation.
- D. Cleaning and Protection:
 - 1. All work shall be kept clean and free of debris as construction progresses. Material finishes shall be protected by covers to prevent impingement of corrosive and abrasive elements. Exterior finish damage shall be repaired to original condition.
 - 2. Refer to Sections 15031 and 15060 for additional pipe cleaning requirements.

1.28. FIELD TESTS/COMMISSIONING

- A. Tests and Adjustments.
 - 1. Upon completion of the installation and before substantial completion of Project, Contractor shall make all necessary tests and adjustments to place the system in working condition. Systems shall be balanced as specified in Section 15990, TESTING, ADJUSTING AND BALANCING. General operating tests shall occur following completion of final testing and balancing, and shall demonstrate that the entire Work is functioning in accordance with Specifications. Furnish all instruments, test equipment, and competent personnel that are required for tests.
 - 2. Final Acceptance Test Inspection.
 - a. Prior to final acceptance of all "Division 15 - Mechanical" equipment, material, systems and subsystems, the Contractor shall demonstrate to the

Design Professional or the Owner that all equipment, systems and subsystems including accessories, appurtenances, controls, safety devices, control and safety device interlocks, etc., function properly in accordance with the contract drawings and specifications and the equipment manufacturer's specifications. The Contractor shall be responsible for any and all costs associated with the tests and demonstrations, including making available equipment manufacturers service representatives to perform those tests or demonstrations that are beyond his capability, or that he prefers not to perform. Refer to Section 15990 for more specific demonstration and testing requirements.

3. Special tests for individual systems may be found specified under the individual specification sections.
 4. Provide factory manufacturer representative start up of the following system and equipment.
 - a. Heat pump specified in Section 15782.
 - b. Energy recovery ventilators specified in Section 15865.
 - c. Automatic control systems specified in Section 15950.
- B. Submit copies of all check out forms for all equipment requirement factory representative start up. Start up forms shall be endorsed by the factory representative doing the start up and a representative of the General Contractor.

1.29. JOB CONDITIONS

A. Job Conditions:

1. Existing Pipe Lines.
 - a. If any water, gas, or other pipes and appurtenances existing or put in service by other contracts are encountered which interfere with the proper installation of new work under this Contract and which will no longer be used after installation of new work, close such appurtenance in a proper manner, and if necessary, move or remove the appurtenances as directed by the Design Professional.
 - b. Where Work installed by other contracts or existing is to be modified, it shall be done in conformance with the Specifications. Materials used shall be same as existing unless otherwise specified.
2. **Contract Drawings and Specifications. Contract drawings are diagrammatic only, and do not give fully dimensioned locations of various elements of work. Verify exact locations from field measurements. General character and scope of work are illustrated on the drawings and/or listed in the Specifications. Drawings and Specifications are complimentary one to the other; whatever is called for by one shall be as binding as if called for by both.**
3. Space Requirements. Consider and coordinate for space, limitations imposed by contiguous work, in selection and location of equipment and material. Do not provide equipment or material which is not suitable in this respect.
4. Obstructions.
 - a. The drawings may indicate certain information pertaining to surface and subsurface obstructions which have been taken from available documentation. Such information is not guaranteed, as to accuracy of location or completeness.
 - b. Before any cutting or trenching operations are begun, verify with the Design Professional, the Owner, and other interested parties that all available information has been provided. Verify locations prior to commencing operations.
 - c. Where unknown obstructions are encountered, alter routing of new work as directed by the Design Professional.
 - d. Contractor shall assume total responsibility for and repair any damage caused to existing known utilities or construction.

B. Sequencing, Scheduling:

1. Coordination of Work.
 - a. Plan all Work so that it proceeds with a minimum of interference with other trades. Inform the General Works Contractor of all openings required in the building construction for installation of Mechanical Work. Provisions shall be made for all special frames, openings, pipe sleeves, and vapor barrier seals as required.
 - b. Verify the Owner's inspection requirements and abide by their rights of inspection before covering or otherwise concealing any piping, wiring, or equipment.
 - c. Order of precedence: the Contractor shall lay out all work well enough in advance to avoid conflicts or interference with other work in progress so that in case of interference the mechanical layout may and shall be altered to suit the conditions, prior to the installation of any work and without additional cost to the Owner. The Contractor shall be responsible to coordinate all work and take all action as required to avoid conflicts between the work of this trade and that of other trades, inclusive of all required operating, code and service access clearances. Unless specifically noted otherwise, establish the exact location of mechanical equipment based upon the actual dimensions of equipment furnished. Mechanical and electrical work shall be coordinated so that work may proceed according to the sequence to avoid conflicts.

1.30. DELIVERY, STORAGE, AND HANDLING

- A. Deliver all equipment with factory-installed (wooden) skids and suitable lifting lugs, or deliver equipment, components, and accessories in factory-fabricated protective containers.
- B. Protect all delivered equipment and materials from foreign matter, weather (rain, snow, wind, dirt/debris) and other damage at all times.
- C. Inspect all equipment and materials for damage prior to installation. Remove from the construction site all damaged or corroded materials and equipment.
- D. Where applicable, comply with manufacturer's rigging instructions for unloading and moving equipment to installation locations(s).
- E. In addition to the above outlined requirements, all piping and shop-fabricated pre-lined and non-lined ductwork sections shall be clear of foreign matter, having temporary end cap enclosures of sufficient tightness to prevent foreign matter entry during shipment, storage, and handling prior to installation.

1.31. ENERGY CONSERVATION REBATE PROGRAM

- A. The Owner may be participating in a utility sponsored Energy Conservation Rebate Program. The design indicated and items specified are based on this program's criteria.
- B. The Division 15 Subcontractor shall provide the Owner with the documentation required by Stuart Municipal Utilities to ensure energy conserving commitments were implemented during the construction process, or to document that certain energy savings components were installed to confirm the specific rebate applicable to the project.

1.32. QUALITY ASSURANCE

- A. Contractors: Only Division 15 Mechanical Contractors that meet the qualification requirements shall bid the job. Only the Division 15 Subcontractors that have a minimum of 5 years experience in commercial, industrial or educational geothermal and water to water and water to air heat pump projects of similar scope and size (at least 10 tons of cooling capacity), shall bid the job. The Owner may require a performance bond and payment bond for the Mechanical Subcontractor. The Mechanical Contractor shall be able to provide such bonds.
- B. The Design Professional will review qualification submittals of the Division 15 subcontractors during the the project submittal phase after a contract award. The qualifications submittal shall contain the following information to be considered as a minimum.
 1. Contractor name and Owner's name if different.
 2. Contractor's 'home' state or business address.

3. Past experience in similar installations. Experience shall be over the past 5 years and shall be for at least 5 years. List projects including historic preservation projects.
4. List of specific job references with contact persons (addresses and telephone numbers).
5. Two Credit and two bank references.
6. Bonding capacity and contractors bonding company. The Owner may require performance and labor and material payment bonds of the Division 15 subcontractor.
7. Qualification certifications of personnel who will be performing the work.
8. Certification that Contractor will be performing mechanical piping and plumbing work with his own forces, and will not subcontract out this piping work.
9. The Design Professional will be the sole judge whether a specific contractor is qualified based on the qualifications submitted. Any decision is final.
10. Only acceptable Mechanical Contractors satisfying the experience requirements will be considered.
11. Document 00150 – Qualification Form for Division 15 Subcontractor is attached to Section 15010. The Contractor shall submit the completed form during the submittal process. The Design Professional will review the proposed subcontractor qualifications after contract award.

1.33. ALTERNATES

- A. Refer to Division 1 and the Bid Form for descriptions of any Alternates.

1.34. USE OF ELECTRONIC VERSIONS OF CONSTRUCTION DOCUMENTS

- A. Concurrent with this understanding, A&J will transmit the project electronic data files for your use. By accepting these files, the Contractor agrees to the conditions *and assumes sole responsibility for their use. Use of the files does not in any way create a contractual relationship between the recipient and A&J Associates, its clients or its consultants.*
- B. The files are work in progress created for and to be used on the above referenced project. The signed and sealed original plans, project manual and other documents constitute the Contract Documents for the project. These electronic data files are not Contract Documents and may be subject to manipulation beyond the control of A&J Associates PC, its clients or its consultants. Therefore, A&J Associates PC, its clients or its consultants cannot verify that the files accurately or completely reflect actual construction or field conditions. The Contractor must satisfy themselves as to the level of accuracy and completeness of the files. In addition, the Contractor understands that the changes made during design, bidding, negotiation, and construction may not be incorporated in the files.
- C. A&J Associates PC, its clients and its consultants provide no warranties, express or implied, including warranties of merchantability and/or fitness for a particular purpose for the files furnished under this agreement.
- D. A&J Associates PC, its clients or its consultants, provide no warranties, expressed or implied, that the electronic data is virus free or that the data conforms to any performance specification.
- E. By acceptance of these files the Contractor covenant not to sue, and agrees to indemnify and hold harmless A&J Associates PC, its clients, and its consultants from any costs (including attorneys' fees), claims or causes of action, be it tort, breach of contract or otherwise that result from the use of these electronic data files, and waive all claims for consequential and/or liquidated damages against A&J Associates PC, its clients, and consultants.
- F. The providing of the files by A&J Associates PC is not construed in any manner to be in derogation of any reserved or intellectual property rights.

**DOCUMENT 00150
QUALIFICATION FORM –SUBCONTRACTORS
DIVISION 15 – MECHANICAL CONTRACTORS**

PROJECT: Stuart Depot Community Building

CONTRACTOR: _____

ADDRESS: _____

CITY, STATE: _____

TELEPHONE: _____ FAX: _____

- A. Answer all of the following questions and submit clear and comprehensive dates. If necessary, answer questions on separate, attached sheets.
- B. How many years has your organization been in business? _____
- C. How many years under the present name? _____
- D. How many years under a previous business name? _____
List other names.

Company name _____ dates

Company name _____ dates

- E. Have you ever failed to complete any work awarded to you? If yes, where and why?

- F. Have you, in the previous five years, been denied a contract award on which you submitted the low bid in competitive bidding? If yes, please list and explain.

- G. List four or more projects of similar nature and scope to this project that you have completed within the past four years and which you were in compliance with the requirements specified for this project. The similar projects shall be projects of 10 tons or larger of cooling capacity of the type of project being bid. Include any historic preservation projects.

Project name	Location	Year	Cost	Owner name/phone #
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Project name	Location	Year	Cost	Owner name/phone #
Project name	Location	Year	Cost	Owner name/phone #
Project name	Location	Year	Cost	Owner name/phone #

H. Which of the above projects required trade skills and construction practices similar to this project?

I. Provide names of key personnel to be employed on this project. Indicate the projects listed in Item G in which they were involved. On attached sheets provide brief resumes of each person, describing specific experience and qualifications which will indicate ability to perform work required on this project.

Name	Years experience	Years with your firm	Projects worked upon
------	------------------	----------------------	----------------------

Name	Years experience	Years with your firm	Projects worked upon
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Name	Years experience	Years with your firm	Projects worked upon
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Name	Years experience	Years with your firm	Projects worked upon
------	------------------	----------------------	----------------------

J. Certify that you will not subcontract out any work, or list work that will be subcontracted.

K. Are you a certified mechanical contractor? If yes, by what organization? If yes, include copy of current certification.

_____ _____
yes no

L. Are you able to provide a performance and payment bonds for the amount of the sub-contract?

_____ _____
yes no

- M. If you are able to provide a performance and payment bond listed above, provide the name and address of the bonding company that would provide your bond for this project. It is estimated that the mechanical sub-contract will be an amount between \$50,000 and \$500,000.

Surety Company

Address

City, State

Telephone

Fax

Contact at the Surety Company

Available or current bonding limits: \$ _____

- N. List two credit and two bank references with addresses and contact telephone numbers.

END OF SECTION 15010

**SECTION 15014
BACKFILLING**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Utility trench backfilling for utilities within the scope of work of Division 15 of this specification.
- B. Consolidation and compaction

PART 2. PRODUCTS

2.1. FILL MATERIALS

- A. Type A - Crushed Gravel: Pit run, angular, natural stone; free of shale, clay, friable material, sand, debris; graded in accordance with ASTM C136 within the following limits:

1. <u>Sieve Size</u>	<u>Percent Passing</u>
a. 2 inches	100
b. 1 inch	95
c. 3/4 inch	95
d. 5/8 inch	75
e. 3/8 inch	55
f. No. 4	35
g. No. 16	15
h. No. 40	10
i. No. 200	5

- B. Type B - Pea Gravel: Natural stone; washed, free of clay, shale, organic matter; graded in accordance with ASTM C136, to the following:

- 1. Minimum size: 1/4 inches
- 2. Maximum size: 5/8 inches

- C. Type C - Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, or organic matter; graded in accordance with ASTM C136 to the following:

1. <u>Sieve Size</u>	<u>Percent Passing</u>
a. No. 4	100
b. No. 14	10 to 100
c. No. 50	5 to 90
d. No. 100	4 to 30
e. No. 200	0

- D. Subsoil: Reused, free of gravel larger than 3 inches size, and debris.

PART 3. EXECUTION

3.1. EXAMINATION

- A. Verify fill materials to be reused are acceptable.

3.2. PREPARATION

- A. Generally, compact sub-grade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of compaction. Backfill with Type C fill and compact to density equal to or greater than requirements for subsequent backfill material.
- C. Prior to placement of aggregate base course material at gravel areas, compact subsoil to 95% of its maximum dry density in accordance with ASTM D698.
- D. Prior to placement of aggregate base course material at paved areas, compact subsoil to 95% of its maximum dry density in accordance with ASTM D698.

3.3. BACKFILLING

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, frozen or spongy sub-grade surfaces. Contractor shall de-water trenches and excavations as he backfills with dry fill material. Contractor shall remove "high" water from the area as he backfills.
- C. Granular Fill: Place and compact materials in continuous layers not exceeding 6 inches compacted depth.
- D. Soil Fill: Place and compact material in continuous layers not exceeding 12 inches compacted depth.

- E. Employ a placement method that does not disturb or damage foundation waterproofing and protective cover, and utilities in trenches.
 - F. Maintain optimum moisture content of backfill materials to attain required compaction density. Take into account the high water table when applying backfill.
 - G. Backfill against supported foundation walls. Do not backfill against unsupported foundation walls.
 - H. Make grade changes gradual. Blend slope into level areas.
 - I. Remove surplus backfill materials from Site.
 - J. Leave fill material stockpile areas completely free of excess fill materials.
- 3.4. FIELD QUALITY CONTROL
- A. Field inspection and testing shall be performed.
 - B. Tests and analysis of fill material shall be performed in accordance with ASTM D1557, ASTM D698.
 - C. Compaction testing shall be performed in accordance with ASTM D1556, ASTM D1557, ASTM D698.
 - D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.
 - E. Proof roll compacted fill surfaces under slabs-on-grade, pavers, and paving.

END OF SECTION 15014

**SECTION 15015
TRENCHING****PART 1. GENERAL****1.1. SECTION INCLUDES**

- A. Excavate trenches for underground utilities within the scope of work of this section.
- B. Compacted bedding under fill over utilities to sub-grade elevations
- C. Backfilling and compaction of trenches.
- D. Refer to other specifications covering paving and landscape repair for these requirements.

1.2. FIELD MEASUREMENTS

- A. Verify that survey benchmark and intended elevations for the Work are as indicated.

PART 2. PRODUCTS**2.1. BACKFILL MATERIALS**

- A. Types A, B, C, and subsoil materials as specified in Section 15014.

2.2. BEDDING MATERIALS

- A. Type A Material: As specified for Type A in Section 15014.
- B. Type B Material: As specified for Type B in Section 15014.
- C. Type C Material: As specified for Type C in Section 15014.
- D. Subsoil Material: As specified in Section 15014.

PART 3. EXECUTION**3.1. EXAMINATION**

- A. Verify fill material to be reused, is acceptable.

3.2. PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Maintain and protect existing utilities remaining, which pass through the work area.
- C. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.
- D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.
- E. Protect above and below grade utilities which are to remain.
- F. Cut out soft areas of sub-grade not capable of compaction. Backfill with Type C fill and compact to density equal to or greater than requirements for subsequent backfill material.

3.3. EXCAVATION

- A. Excavate subsoil required for geothermal heat pump loop piping, sanitary sewer, domestic water, natural gas and electrical service to points of connection indicated on the Drawings, and other utilities from the building edge to a point approximately 5 feet-0 inches beyond the edge.
- B. Cut trenches sufficiently wide to enable installation of utilities and allow inspection.
- C. Excavation shall not interfere with normal 45 degrees bearing splay of foundations.
- D. Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- E. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard, measured by volume.
- F. Correct unauthorized excavation at no cost to Owner.
- G. Correct areas over-excavated by error.
- H. Stockpile excavated material in area designated on the Site and remove excess material not being used, from the Site.

3.4. BEDDING

- A. Support pipe and conduit during placement and compaction of bedding fill.

3.5. BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy sub-grade surfaces. Refer to Section 15014 for backfilling "wet" areas.
- C. Granular Fill: Place and compact materials in continuous layers not exceeding 6 inches compacted depth.

- D. Soil Fill: Place and compact material in continuous layers not exceeding 12 inches compacted depth.
- E. Employ a placement method that does not disturb or damage foundation perimeter drainage, foundation waterproofing and protective cover, and utilities in trenches.
- F. Maintain optimum moisture content of backfill materials to attain required compaction density.
- G. Remove surplus backfill materials from the Site.
- H. Leave fill material stockpile areas completely free of excess fill materials.

3.6. FIELD QUALITY CONTROL

- A. Field inspection and testing shall be performed.
- B. Tests and analysis of fill material shall be performed in accordance with ASTM D1557, ASTM D698
- C. Compaction testing shall be performed in accordance with ASTM D1556, ASTM D1557, TM D698.
- D. If tests indicate the Work does not meet specified requirements, remove the Work, replace and retest.

END OF SECTION 15015

**SECTION 15020
LOUVERS****PART 1. GENERAL****1.1. SECTION INCLUDES**

- A. Aluminum louvers at air intakes or exhausts.

1.2. SUBMITTALS

- A. Submit louver color chips for checking of the color by the Design Professional to confirm the color specified by the Design Professional for the exterior finishes.
- B. Submit samples, minimum size 3 inches x 6 inches, of finish selected on the actual base metal.
- C. Submit shop drawings indicating in large scale, profile of frame and installation details, flashing, blade configuration, connections to duct work, wall boxes, insect screen, percentage of free air opening, pressure drop, and water entrainment performance curves.

PART 2. PRODUCTS**2.1. MATERIALS**

- A. Louvers:
 - 1. Design is based upon Greenheck Storm Proof High Performance ESD 405 drainable blade louvers.
 - 2. Design Professional approved equal by Ruskin, Louvers & Dampers, Inc. or NCA will be acceptable.

2.2. MATERIALS

- A. Horizontal Line (Continuous Fixed Blade) Louver
 - 1. Extruded aluminum, type 6063-T52 aluminum.
 - 2. Depth: 4 inches.
 - 3. Blade angle: 45 degrees.
 - 4. Free air area: approximately 50% (based upon 48 inches x 48 inches size).
 - 5. Frame and blade thickness: 0.125 inch thick
 - 6. Blades shall be supported and aligned with heavy gage aluminum braces, positively interlocked to each blade and mechanically secured to 2 inches x 2 inches x 1/4 inches angles with aluminum or stainless steel fastenings.
 - 7. Bird screen mesh, 16 gage aluminum, secured in removable aluminum frame.
 - 8. Finish: bronze coating, baked enamel.
- B. Performance
 - 1. Intake louvers shall be sized and designed to prevent water and snow entrainment for the indicated air flow and louver face velocity.
 - 2. Provide the performance curves for the louvers provided.

PART 3. EXECUTION**3.1. INSTALLATION**

- A. Locate and place louver units plumb, level, and in proper alignment with adjacent work.
- B. Secure louver rigid with concealed fasteners of non-corrosive metals to suit adjacent materials.
- C. Use concealed anchorage where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- D. Form closely fitted joints with exposed connections accurately located and secured.
- E. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- F. Repair finishes damaged by cutting, welding, soldering, and grinding operations required for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items which cannot be refinished in field to shop. Make required alterations and refinish entire unit, or provide new units.
- G. Coordinate installation method with application of exterior materials and mechanical work.
- H. The Division 15 Contractor shall be responsible for locating ducted openings, cutting openings in backing panel and attaching ductwork to louver metal backing panel. The

General Works Contractor shall be responsible for constructing building frame works and adjacent wall material interfacing with the louvers. Coordinate with affected contractors.

- I. Install removable bird screens.
 - J. Install concealed gaskets, flashing, joint fillers, and insulation, as louver installation progresses where required to make louver joints weather-tight. Comply with architectural "Joint Sealers" requirements for sealants applied during installation of louver.
 - K. Coordinate required louver openings with the masonry and/or wall structure contractor so openings and louver are in the required location and are the specified size.
 - L. The louvers shall be attached to the exterior walls in accordance with the details indicated on the architectural drawings for unit outside air intake boxes, and for the other air intakes and exhaust louvers. Louver frames shall be provided that enhance the installation. Provide flush mounted louvers in masonry walls and louvers with flange edges in panel walls.
- 3.2. ADJUSTING AND PROTECTION
- A. Protect louvers from damage of any kind during construction period including use of temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at time of Substantial Completion.
 - B. Restore louvers damaged during installation and construction period, so that no evidence remains of correction work. If results of restoration are unsuccessful, as judged by Design Professional, remove damaged units and replace with new units.
 - C. Clean and touch-up minor abrasions in finishes with air-dried coating that matches color and gloss, and is compatible with, factory-applied finish coating.
 - D. Test operation of adjustable wall louvers and adjust as needed to produce fully functioning units which comply with requirements.
- 3.3. CLEANING
- A. Periodically clean exposed surfaces of louvers, which are not protected by temporary covering, to remove fingerprints and soil during construction period; do not let soil accumulate until final cleaning.
 - B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Rinse thoroughly and dry surface.

END OF SECTION 15020

**SECTION 15031
GEOTHERMAL LOOP FIELD**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Under this contract provide the geothermal loop field for the HVAC heat pump system, heat exchanger and site distribution piping, and the loop header manifold, and piping mains between the field and inside piping as specified in Section 15031. The Division 15 Subcontractor and the loop field subcontractor shall coordinate the overall heat pump system installation, sequencing, check-out, fluid filling and systems commissioning with Loop Field Contractor.
- B. The geothermal loop field shall be the horizontal bore system (HBS) as specified on the drawings.
- C. No other alternatives will be considered for the geothermal loop field, horizontal bore configuration.
- D. The design of the loop field was based upon the use of the ground source heat pumps and of the manufacturers and model numbers indicated on the drawings. It is recognized that the loop field requirements may vary depending upon the manufacturer and model number of the heat pumps being provided. The design of the loop field shall be revised as necessary to reflect the heat pumps being provided to ensure the minimum specified heating and cooling performance are provided by the loop field. Refer to Part 3 for the soil conductivity, diffusivity and temperature properties used for sizing the loop field. The Contractor shall use this data for determining the actual loop field size.
- E. The Loop Field Contractor shall be advised of the potential for high water table level existing at the site and the need for "de-watering" during installation of underground utilities.
- F. This design has been prepared in accordance with the materials standards and accepted installation practices of the International Ground Source Heat Pump Association (IGSHPA). The Loop Field Contractor shall comply with these standards and practices along with all state and local regulations pertaining to the installation.
- G. The Loop Field Contractor shall be responsible for all aspects involved with the complete geothermal loop field installation. All materials, drilling, excavation, hauling of backfill, pumping, de-watering, cleanup of site, soil compaction, testing, flushing, fluid fill, and labor required shall be included in the contract price. For purposes of this contract the loop field work shall include the loop field, distribution piping, piping between the headers and the building up to isolation valves inside the mechanical space near the circulating pumps, testing and flushing of piping and filling of the loop field with chemical water mixture. The chemical water mixture used to fill the loop field shall be identical to fluid used to fill the inside piping. Loop field shall include loops, circuits, mains, and headers inside the building, and isolation valves inside the building.
- H. The Loop Field Contractor shall take note: there is no guarantee to the loop field contractor that the location of any existing utilities are exactly as indicated on the drawings. Some areas may require hand digging to locate that utility. The loop field contractor shall include in the contract price the repair of any domestic water, electrical, communication or any service line that may be damaged during the construction of the geothermal loop field portion of the project. Any offsets required to route over or under existing lines shall also be included in the geothermal loop field contract price of the project.
- I. The Loop Field Contractor shall cooperate with the General Contractor and Division 15 Subcontractor while providing the geothermal loop field.

1.2. JOB CONDITIONS

- A. Give adequate notice to the City of Stuart, County of Adair, Utility Companies, General Contractor, Owner and Design Professional of the proposed work.
- B. Protect existing utilities during excavation and boring. If utility lines are encountered or damage there were not indicated, notify the Owner and Design Professional immediately.

- C. Coordinate placement of pipe trenches, horizontal bores and other components with parking lot and parking lot lights and underground supports, sidewalks, landscaping, underground utilities, paving and building foundations. Refer to plans for indication of where these items are planned for on the site.
- D. The Loop Field Contractor shall be responsible for obtaining the needed approval to set up an adjacent properties not under the Owner's Control as required to install the loop field.

1.3. QUALIFICATIONS

- A. The Loop Field Contractor shall have on the project a certified IGSHPA installer. The loop field contractor performing this work shall have a minimum of five (5) years experience in performing underground closed circuit loop field work of at least 20 tons and larger. The Loop Field Contractor shall have completed at least 30 horizontal bore loop fields of over 20 tons in the last five years.
- B. Loop field fabricators shall be heat fusion certified by an authorized high-density polyethylene (HDPE) pipe manufacturer's representative of the brand of pipe used. Certification shall include: successful completion of a written heat fusion exam as well as demonstrating proper heat fusion techniques under the direct supervision of the authorized HDPE pipe manufacturer's representative.
- C. The loop field contractor shall be certified by the Iowa DNR as a well installer in the State of Iowa.
- D. The Loop Field Contractor shall perform all horizontal boring with his own forces. This work shall not be sublet to any other boring contractor. The Loop Field Contractor shall certify that he will self perform the horizontal boring.
- E. The Owner may elect to require performance and payment bonds of the geothermal loop subcontractor. The loop field subcontractor shall be able to provide such bonds.
- F. The Design Professional will review qualification submittals of the horizontal directional boring contractors during the shop drawing submittal phase of the project. The qualifications submittal shall contain the following information in order to be considered further.
 - 1. Contractor name and Owner's name if different.
 - 2. Contractor's home state or business address.
 - 3. Past experience in horizontal bore geothermal installations. Experience shall be over the past ten years and shall be for jobs larger than 20 tons with horizontal bores at 15'-0 inches or deeper below the surface.
 - 4. List of specific job references with contact persons (addresses and telephone numbers).
 - 5. Credit and bank references.
 - 6. Bonding capacity and contractors' bonding company. The Owner reserves the right to require a special performance bond of the geothermal contractor.
 - 7. Qualification certifications of personnel who will be performing the work.
 - 8. Certification that Contractor will be performing work with his own forces, and will not subcontract out the work.
 - 9. Provide manufacturer, make and model number of boring machines and grout placement pumps and feeders.
- G. The Design Professional will be the "sole" judge whether a specific loop field contractor is qualified based on the qualifications submitted. Any decision is final.

1.4. SUBMITTALS

- A. Submit the current IGSHPA installer certification for review and acceptance as part of the contractors qualification submittal.
- B. Submit the heat fusion certifications of high density polyethylene (HDPE) piping for the installers on the job as part of the loop field shop drawing submittal.
- C. Submit shop drawings and certification for the loop field, grout, piping and other materials proposed for the project. The loop field design drawings shall indicate the finished design of the loop field that incorporated changes necessitated by field conditions or modifications to match the heat pumps furnished for the job.
- D. Submit written test, flushing and filling procedures to be used for the project.

- E. Submit test and flushing results for the loop field and loop field chemical, glycol/ water mixture after the system fill has been completed.
- F. Submit the Iowa DNR certification as a well installer as part of the geothermal loop system submittals.
- G. Listing of grout material on the Iowa DNR approved grouting material list.
- H. Submit test results of a sample of the chemical mixture from the tanker or other container prior to filling the piping system. Also submit test results of the chemical water mixture taken from the piping after circulating for five days.
- I. **Grout samples to be tested by an independent testing laboratory. Submit grout test results as soon as they are ready to be submitted. Do not wait until the end of the work to submit sample reports.**
- J. Submit listing of chemicalwater/inhibitor/ glycol mixture on the Iowa DNR approved chemical mixture list for use in contact with ground water.
- K. Submit loop field plans and specifications for review and acceptance to Iowa DNR and Adair County Health Department.

1.5. RELATED SPECIFICATIONS

- A. Refer to Sections 15014 - Backfilling 15015 - Trenching for additional requirements.

PART 2. PRODUCTS

2.1. MATERIALS

- A. Specifications for the polyethylene heat exchanger:
 - 1. General: all pipe and heat fused materials shall be manufactured from a virgin polyethylene extrusion compound material in accordance with ASTM D2513, Sections 4.1 and 4.2. Pipe shall be manufactured to outside diameters, wall thickness and respective tolerances as specified in ASTM D3035 or D2447. Fittings shall be manufactured to diameters, wall thickness and respective tolerances as specified in ASTM D2683 for socket fittings and ASTM F1055 for electrofusion fittings. **Do not use any CPVC piping for any mains in the geothermal loop piping system.**
 - 2. Material: the material shall maintain a 1600 psi hydrostatic design basis at 73.4⁰ F. per ASTM D2837 and shall be listed in PPI TR4 as a PE3408 piping formulation. The material shall be a high density extrusion compound having a cell classification of PE345434, PE355434 or PR345534 with a UV stabilizer of C, D or E as specified in ASTM D3350 with the following exception: this material shall exhibit zero failures (FO) when tested for a minimum of 192 hours under ASTM D1693, condition C, as required in ASTM D3350.
 - 3. Dimensions"
 - a. Pipe with a diameter of less than 1-1/4 inches (nominal) shall be manufactured in accordance with ASTM D3035 with a minimum (based on pressure rating) dimension ration of 11.
 - b. Pipe manufactured with a diameter of 1-1/4 inches (nominal) and larger shall be manufactured in accordance with ASTM D3035 (minimum based on pressure rating dimension ratio of 15.5) or ASTM D2447 (Schedule 40).
 - c. Pipe 3 inches (nominal) and larger shall be manufactured in accordance with ASTM D3035, (with a minimum based on pressure rating dimension ration of 17) or D2447 (Schedule 40).
 - d. Table of Water Pressure Ratings at 73.4⁰ F. for DR-PR PE 3408 Plastic Pipe.

Dimension Ratio	Pressure Rating, psi
7	267
9	200
9.3	193
11	160
13.5	128
15.5	110
17	100

4. Each pipe shall be permanently indent marked with the manufacturer's name, nominal size, pressure rating, relevant ASTM standards, cell classification number and date of manufacture. All piping used for the loop field for bore holes (pipe located in bore holes) shall have factory hot-stamped lengths impressed on the side of the piping indicating the length of the pipe at that point. The length stamp shall read zero on one end and the actual borehole total length on the other end.
 5. U-bends: the loop field bore shall have a factory fused u-bend with pipe lengths long enough to reach grade from the bottom of the bore so no field fusions are required below the header pit. Approved pipe manufacturer shall be Performance Pipe or Design Professional approved equivalent.
- B. Fittings: Pipe fittings shall meet the requirements of ASTM D2683 (for socket fusion fittings) or ASTM D3261 (for butt/saddle fusion fittings). Each fitting shall be identified with the manufacturer's name, nominal size, pressure rating, relevant ASTM standards and date of manufacturer. Saddle fusions are not allowed except when performed by a geothermal HDPE custom fabrication company.
- C. Infield Extended Headers: The infield extended headers used to connect the heat exchanger u-bends in each circuit shall be constructed as shown on project drawings. Infield extended headers shall be manufactured by a geothermal HDPE fabrication company. The Contractor may field fabricate the extended headers from HDPE piping as long as actual fabrication personnel are certified in HDPE fusion welding as indicated by certifications included in submittal.
- D. Manifold: The manifold used to connect all heat exchanger circuits shall be constructed as shown on the drawings. The manifold piping shall be manufactured from HDPE piping and performed by a geothermal HDPE custom fabrication company. Manifolds may be field fabricated from HDPE pipe as long as field fabricators of HDPE manifolds are certified to perform fusion welding.
- E. The u-bend heat exchanger pipes shall be placed in the bores using the specified grout by the following methods.
1. Use thermally enhanced bentonite grout to enclose the u-bend piping circuit and seal the entire bore hole. The thermally enhanced grout shall have a minimum thermal conductivity of 0.88 Btuhr/ft F., and a permeability rate of less than 1×10^{-7} cm/sec.
 2. The grout material shall be listed on the Iowa DNR listing for approved grouts for use in sealing well casings.
 3. The horizontal bores shall be filled by pumping grout through a tremie pipe.
- F. Warning tape: warning tape shall be foil backed, 2 inches wide or greater with a continuous message printed every 36 inches or less reading: "CAUTION GEOTHERMAL PIPELINE BURIED BELOW". The tape shall be highly resistant to alkalis, acids and other destructive agents found in the ground. Provide warning tape to indicate the location of horizontal and vertical portions of the entire geothermal loop field. Provide heat exchanger loop piping and field location using GPS technology.
- G. Good quality threaded fittings and a thread sealant specified for use with the antifreeze selected shall be used. Some antifreeze solutions require more fittings torque than others to prevent leaks and corrosion of external surfaces when the antifreeze is exposed to oxygen.
- H. Antifreeze:
1. Antifreeze solutions shall meet local and state requirements and be USDA approved food grade and be acceptable by component manufacturers:
 2. All GHP systems shall be labeled and identified at the loop charging valves:
 - a. Antifreeze type and concentration
 - b. Service date
 - c. Company name
 - d. Company phone number and responsible party or person

3. Form: these standards are intended to cover corrosion-inhibited, biodegradable, food grade, propylene glycol liquid antifreeze materials as received at the job site.
4. Application: for use in closed-loop geothermal heat pump systems for the transfer of energy to provide heating and cooling in residential and commercial applications.
5. Safety: while these standards attempt to define antifreeze materials characteristics that are safe to environment and personnel, it is the sole responsibility of the user to become familiar with the safe and proper use of materials provided under these standards and to take necessary precautionary measures to insure the health and safety of all personnel involved.
6. Technical requirements:
 - a. Material: the composition of the fluid shall be at the option of the manufacturer. The fluid may contain corrosion inhibitors, etc., as required to produce a product meeting the specified requirements.
 - (1) Biodegradability: the fluid shall not be less than 90% biodegradable. Results of biodegradable studies conducted in accordance with "Standard Methods for the Examination of Water and Waste Water" for biodegradability and bioassay shall, when requested by the Owner, be provided by the fluid manufacturer to the Owner and shall contain not less than the following information:
 - (a) A statement of ecological behavior of the fluid.
 - (b) The total oxygen demand (TOD) of the fluid, expressed in pounds of oxygen per pound of fluid.
 - (c) The percent of the fluid degraded in five (5) days.
 - (2) Corrosion: the fluid shall demonstrate low corrosion to internal surface of all materials found in geothermal heat pump systems.
 - (3) The propylene glycol water mixture shall be 30% glycol/70% water nominally. The heat pump system has been designed on this ratio. The glycol water mixture shall be pre-mixed and shall contain de-mineralized or de-ionized water.
 - b. Properties: The fluid shall conform to the following requirements, and tests shall be performed in accordance with specified test methods on the fluid:
 - (1) Flash point: shall not be lower than 194^oF. determined in accordance with ASTM D92.
 - (2) Biological oxygen demand; Five days BOD at 50^oF. shall not exceed 0.2 gram oxygen per gram nor be less than 0.1 gram oxygen per gram.
 - (3) Freezing point: shall not exceed +18^oF. determined in accordance with ASTM D1177.
 - (4) Toxicity: shall not be less than LD 50 (oral-rats) of 5 grams per kilogram. The NFPA hazardous material rating for health shall not be more than 1 (slight).
 - (5) Storage stability: the fluid, tested in accordance with ASTM F1105, shall show neither separation from exposure to heat or cold, nor show an increase in turbidity.
 - c. Quality: the fluid, as received by the Owner, shall be homogenous, uniform in color and free from skins, lumps, and foreign materials detrimental to usage of the fluid.
7. Packaging and identification:
 - a. Fluid shall be delivered in bulk. Make up fluid shall be packaged in container and size agreed upon by the Owner.
 - b. Containers of fluid shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging and transportation of the fluid to ensure carrier acceptance and safe delivery.

- c. An up-to-date Material Safety Data Sheet shall be supplied to the Owner upon request and concurrent with each delivery.

PART 3. EXECUTION

3.1. INSTALLATION

- A. Drilling: the horizontal boreholes shall be drilled to a depth allowing complete insertion of the heat exchanger to its specified depth. The maximum borehole diameter shall be six (6) inches. If a larger diameter is required, it must be approved by the Design Professional.
- B. Grouting procedures: the bore hole shall be grouted from the end point back in a continuous fashion using at least a 1 inch HDPE tremie pipe. The tremie pipe shall be pulled out during the grouting procedure maintaining the pipe's end just below grout level within the borehole. All state regulations shall be met for borehole grouting. The Loop Field Contractor may increase the tremie pipe size if needed to reduce the grout pumping friction.
- C. Heat fusion pipe joining: all underground pipe joining shall be heat fused by socket, butt or saddle (sidewall) fusion in accordance to ASTM D2610, ASTM D2683 and the manufacturer's heat fusion specifications. The operator shall be heat fusion certified and experienced in executing quality fusion joints. The u-bends shall be factory applied so there will be no field joints in the bore holes.
- D. Fusion transition fittings with threads shall be used to adapt to copper. Fusion transition fittings with threads or barbs shall be used to adapt to high strength hose. Barbed fittings are not permitted to be connected directly to polyethylene pipe. All mechanical connections shall be accessible.
- E. Excavation and backfilling for piping:
 - 1. The Loop Field Contractor shall do all excavating, backfilling, shoring, de-watering, bailing and pumping for the installation of the work and perform necessary grading to prevent surface water from flowing into trenches or other excavations. Sewer lines shall not be used for draining trenches and the end of all pipe and conduit shall be kept sealed and lines left clean and unobstructed during construction. Only material suitable for backfilling shall be piled a sufficient distance from banks of trenches to avoid overloading. Unsuitable backfill material shall be removed from the site as directed by the Design Professional. The loop field contractor shall be responsible for cleaning up site of excess grout, mud, and water resulting from the installation process.
 - 2. Sheathing and shoring shall be done as necessary for protection of work and personnel safety. Unless otherwise indicated, excavation shall be open cut, except for short sections.
 - 3. The loop field contractor shall install geothermal locating (warning) tape 18 inches above all horizontal/header piping and above mains to the building. The loop field contractor shall install "locator" wire in each bore hole so the loops can be located in the future and shall provide GPS locations of the loops.
 - 4. Prior to drilling or trenching, the loop field contractor shall be responsible for reviewing with the City of Stuart and Adair County, Utility companies, Owner and Design Professional the location of underground utilities. Existing utility lines uncovered during excavation shall be protected from damage during excavation and backfilling.
 - 5. The Geothermal Loop Contractor shall provide landscape repair, re-sodding, re-seeding or other repair measures to return loop field to the undisturbed condition.
- F. Pipe installation:
 - 1. The u-bend pipe ends shall be sealed with fusion caps or tape prior to insertion into the borehole. Reasonable care shall be taken to ensure that the geothermal loop field pipe is not crushed, kinked, or cut. Should any pipe be damaged, the damaged section shall be cut out and the pipe reconnected by heat fusion.
 - 2. The heat exchanger loop shall be connected as indicated on the plans. The header design accounts for balanced flow as well as flushing and purging flow rates. No variations can be made in the circuit hookup or the pipe sizes that are

indicated without approval from the Design Professional. The minimum bend radius for each pipe size shall be 25 times the nominal pipe diameter or the pipe manufacturer's recommendations, whichever is greater. The depth of all headers and supply and return piping is indicated on the drawings and shall be maintained.

3. Circuits shall be pressure tested before any backfilling of the header trenches is executed. The individual circuits shall be pressure tested with water at 100 psi, however, not to exceed DR 11 pipe working pressure at bottom of the u-bend pipe, in accordance with mechanical code requirements.
 - G. All buried loop field piping passing parallel within 5'-0 inches of any wall, structure, water pipe or sewer pipe or passing through or perpendicular to these items shall be insulated with Type 1 elastomeric insulation, R2 minimum closed cell insulation. Refer to Section 15250 for specifications. This includes the risers coming into the equipment room in the building. The insulation shall be suitable for use under ground.
- 3.2. TESTING, CLEANING, FLUSHING, PURGING, FILLING, GROUT TESTING, LOGS, BALANCING
- A. During installation, all debris shall be kept out of the pipe. Ends of the HDPE pipe shall be sealed until the pipe is joined to the circuits.
 - B. All fusion joints and loop lengths shall be checked to verify that no leaks have occurred due to fusion joining or shipping damage.
 - C. All loops shall be pressure tested before installation and all horizontal components of the ground heat exchanger shall be pressure tested prior to backfilling.
 - D. Heat exchangers shall be pressure tested hydrostatically at the smaller of 150% of the pipe design or 300% of the system operating pressure, but not less than 100 psig with water. The Loop Field Contractor may test the piping using clean compressed air the smaller of 125 percent of design pressure or 250 percent of system operating pressure but not less than 85 psig for air testing. The Loop Field Contractor shall take the necessary safety precautions when testing with air to prevent damage to components or injury to personnel.
 - E. No leaks shall occur within a 30-minute period.
 - F. Flow rates, temperature drops and pressure drops shall be compared to values specified on the drawings to assure that there is no blockage or kinking of any pipe.
 1. The Division 15 Subcontractor and geothermal loop field contractor shall check the field performance as follows. The Testing and Balance Subcontractor to Division 15 Subcontractor shall perform these tests and record and submit results. Refer to Section 15990 for overall HVAC system testing requirements.
 - a. Prepare for test by placing all heat pumps in the "flush mode" to allow all geothermal flow to pass through heat pumps.
 - b. Set all pumps to cooling or heating depending on what "season" is being checked. Activate the heat pumps through the control system override of the local thermostats.
 - c. Set the geothermal loop pumps to maximum flow rate set the heat pump system bypass pressure control valves to allow "full flow" to the loop field. Record inlet and outlet pressure and variable speed drive output. Report pump flow rate. If constant speed pumps are provided open up the balance valves to check different flow rates.
 - d. Record inlet and outlet pressure and inlet and outlet temperature across each circuit at the header, and at the common mains from the header.
 - e. Use "Petes" plugs for temperature and pressure readings.
 - f. Compare the actual readings at each circuit with the design basis levels specified. Correct obvious deficiencies such as field bypasses, air locks, and closed circuits. Redo tests after repairs are made.
 - g. Isolate pipe circuits to find problem indicated by the tests.

- M. The heat pump geothermal field makes up part of the energy storage HVAC system. Starting the geothermal heat pump system at either extreme cold or extreme hot and humid conditions without any energy storage capacity may result in over all system failures, including overheating of the loop, sub-cooling of the loop, tripping heat pumps, loss of heat pump refrigerant gas and loss of system ability to either heat or cool the space. The Contractor (Division 15) shall be responsible for providing the following if needed to start the system.
1. Temporary heat to "warm" building to at least 40⁰F.
 2. Close or seal all temporary opening in building shell to reduce exfiltration and infiltration.
 3. Temporary heat rejection sinks to reject excess upon start up of system in high temperature and humidity conditions.
- 3.3. SOIL PROPERTIES
- A. The geothermal loop field heat exchanger was designed assuming a soil conductivity of 0.80 Btu/hr formation diffusivity of 0.58 ft²/day, and undisturbed formation temperature of 56⁰F.
 - B. The Section 15031 installation shall be based on these assumptions.
 - C. The Design Professional added two extra bores to the loop field than were required by the sizing calculation/computation to conservatively account for not having a conductivity test performed. The Loop Field Contractor shall not eliminate this requirement for an extra two bores above the number required by the calculation.

END OF SECTION 15031

**SECTION 15050
MECHANICAL BASIC MATERIALS AND METHODS**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Mechanical basic materials and methods.

1.2. SUBMITTALS

- A. Submit motor shop drawings with each equipment submittal that includes a motor.

PART 2. PRODUCTS

2.1. ELECTRIC MOTORS/STARTERS

- A. All motors provided by the Contractor shall deliver their rated output continuously with temperature rise not to exceed 80°C and shall have, class B insulation, withstand a 50% overload momentarily without injurious heating. Motors shall be capable of operating continuously at voltage indicated plus or minus 10 per cent without any failure or loss of performance.
- B. Belt driven equipment to have slide rail bases for belt adjustment. All belt guards shall be four sided fully enclosing all moving parts and belts shall be fully ventilated.
- C. If mechanical equipment provided by this section requires larger motors and correspondingly larger electrical service including all appurtenances, this section shall be responsible for the additional costs over the system costs of the original design of the electrical systems as well as the mechanical systems.
- D. All combination starters and disconnect switches at remote starters shall be provided by Electrical Contractor. Unit mounted starters and disconnects at the remote equipment shall be provided by Division 15.
- E. All electric motors shall meet "premium" efficiency requirements of International Energy Conservation Code or as follows, whichever requirements are more stringent:
 - 1. Unless otherwise required, provide motors of open dripproof (ODP) construction. For outdoor applications, applications subject to weather, or as specified, provide totally enclosed, fan cooled (TEFC) motors with a corrosion resistant drain plug under each bearing. Refer to specific technical sections for other motor requirements.
 - 2. Efficiency. All motors (except two-speed motors) 3/4 HP and larger shall be of the high efficiency "premium" type. Provide General Electric "Energy Saver", Westinghouse "Tee 11", U.S. Motors "XB", Baldor "Super-E" motors or Century "High Efficiency". Guaranteed minimum full load efficiencies shall be certified in accordance with IEEE Standard 112 Test Method B, NEMA MG-1-1998, Revision 2, Section 1260 and shall meet or exceed the values listed in NEMA MG1, Table 12-12 (March 1998) or following minimum efficiency and power factor criteria, whichever is more stringent:

MINIMUM NOMINAL EFFICIENCY AND POWER FACTOR FOR OPEN MOTORS

HP	RPM							
	900 EFF	PF	1200 EFF	PF	1800 EFF	PF	3600 EFF	PF
3/4	--	--	81.5	70.0	--	--	--	--
1	81.5	--	82.5	74.0	85.5	84.0	--	--
1½	82.5	--	86.5	73.0	86.1	85.7	84.0	85.1
2	84.0	--	87.5	75.0	86.5	85.7	85.5	87.3
3	84.0	--	89.5	71.0	89.5	85.5	86.5	85.7
5	87.5	70.5	89.5	75.0	89.5	88.0	87.5	86.9
7½	87.5	72.0	89.5	80.5	90.2	81.7	89.5	88.2
10	89.5	78.0	90.2	80.5	91.7	81.0	90.2	86.3
15	89.5	78.0	91.7	84.0	91.7	86.0	91.7	89.2
20	90.2	77.5	92.4	85.0	92.4	86.5	92.4	89.8
25	90.2	78.0	93.0	83.5	93.6	87.5	92.4	92.0
30	91.7	78.0	93.6	83.5	94.1	88.5	93.0	91.7
40	91.7	78.0	94.1	85.5	94.1	89.0	93.0	88.6
50	91.7	84.0	94.1	85.5	94.5	88.5	94.1	88.7
60	92.4	83.5	94.5	85.5	95.0	88.5	94.1	88.5
75	93.0	85.0	94.5	86.0	95.0	88.5	94.1	88.0
100	93.0	84.0	95.0	85.5	95.4	88.0	94.5	88.0
125	93.6	83.5	95.4	88.5	95.4	88.0	95.0	88.0
150	93.6	85.0	95.4	85.5	96.2	88.0	95.4	88.0
200	--	84.0	95.4	86.5	96.2	89.0	95.4	94.0
250	--	82.5	--	--	96.2	83.0	95.8	89.5
300	--	82.5	--	--	96.5	84.0	95.8	--

MINIMUM NOMINAL EFFICIENCY AND POWER FACTOR FOR TEFC MOTORS

HP	RPM							
	900 EFF	PF	1200 EFF	PF	1800 EFF	PF	3600 EFF	PF
3/4	--	--	81.5	70.0	--	--	--	--
1	81.5	--	82.5	74.0	85.5	85.5	77.0	--
1½	82.5	--	87.5	73.0	86.5	85.7	84.0	85.1
2	84.0	--	88.5	75.0	86.5	85.7	85.5	87.3
3	84.0	--	89.5	71.0	89.5	85.5	86.5	85.7
5	87.5	70.5	89.5	75.0	89.5	88.0	88.5	86.9
7½	87.5	72.0	91.0	80.5	91.7	81.7	89.5	88.2
10	89.5	78.0	91.0	80.5	91.7	81.0	90.2	86.3
15	89.5	78.0	91.7	84.0	92.4	86.0	91.7	89.2
20	90.2	77.5	92.4	85.0	93.0	86.5	92.4	89.8
25	90.2	78.0	93.0	83.5	93.6	87.5	92.4	92.0
30	91.7	78.0	93.0	83.5	93.6	88.5	93.0	91.7
40	91.7	78.0	94.1	85.5	94.1	89.0	93.0	88.6
50	91.7	84.0	94.1	85.5	94.5	88.5	94.1	88.7
60	92.4	83.5	94.5	85.5	95.0	88.5	94.1	88.5
75	93.0	85.0	94.5	86.0	95.4	88.5	94.1	88.0
100	93.0	84.0	95.0	85.5	95.4	88.0	94.5	88.0
125	93.6	83.5	95.0	88.5	95.8	88.0	95.0	88.0
150	93.6	85.0	95.8	85.5	96.2	88.0	95.4	88.0
200	--	84.0	95.8	86.5	96.2	89.0	95.4	94.0
250	--	82.5	--	--	96.2	83.0	95.8	89.5
300	--	82.5	--	--	96.5	84.0	95.8	--

FRACTIONAL HORSEPOWER MOTOR EFFICIENCIES

HP	Minimum Efficiency (%)
1/20	35
1/10	35
1/8	35
1/6	35
1/4	54
1/3	56
1/2	60

3. Bearings: Supply motors with antifriction bearings conservatively rated for long life under the total radial and thrust loads produced by the motor and driven equipment. Bearings in fractional horsepower motors shall be the grease packed, sealed type. Integral motor bearings shall be grease lubricated; include alemite fittings and pressure relief devices in locations suitable for in-service lubrication.
 - a. Bearings for motors shall have an L-10 life of 30,000 hours.
 - b. Refer to individual section for other equipment bearings requirements.
4. Motors shall have thermal overload protection by this work category.
5. Motor shop drawings shall include motor efficiencies. Submit motor shop drawings with each submittals for equipment containing motors.
6. The Owner may be awarded an energy savings system rebate from the Utility Companies. The rebate will be based in part on the use of "Premium Efficiency" motors. Contractor shall provide the Premium efficiency motors specified to meet the rebate requirements.

2.2. PIPE STANDS

- A. Pipe stands shall consist of two or more sets of pipe columns with the columns of each set joined by pipe beams. All pipe joints made with welded fittings and tank cradles shall be strapped or bolted to pipe beams. Floor loading shall not exceed the safe load for floor on which placed.
- B. Pipe shall be new, black steel, schedule 40 or heavier, painted same as associated piping.

2.3. EQUIPMENT FURNISHED BY CONTRACTOR OR OTHER SECTIONS/EQUIPMENT ISOLATION

- A. Provide connections to equipment furnished by other Sections providing such accessories as may be specified herein. Inspect other sections of the specifications and plans carefully to determine requirements for this Section.
- B. The Contractor shall provide rough-ins for Owner furnished and installed equipment as specified in the specific section. The Contractor shall provide all necessary service connections to make systems completely operational. Contractor shall verify all connection requirements from certified shop drawings before beginning construction.
- C. In all cases furnish ball valves (stops) or gas or refrigerant cocks at all equipment for all services, and complete installation of equipment in building regardless of what section specifies the equipment.

2.4. EQUIPMENT SUPPORTS

- A. All suspended mechanical equipment shall be supported by structural steel shapes furnished and installed by this Contractor. All supports shall be installed and fabricated in an approved manner coordinated with the equipment manufacturer. All screws, bolts, etc., for mounting exposed to weather shall be brass with lead washers. Where special isolation bases required, they are covered elsewhere in these specifications.

2.5. FLASHING

- A. All pipes and ductwork passing through the roof or other exterior waterproofing membranes shall be flashed to match the roofing water proof membrane or the exterior waterproofing membrane.

2.6. CEILING, WALL AND FLOOR PLATES

- A. All ceiling, wall and floorplates shall be chrome plated pressed steel plates. Floor plates shall be installed around pipe sleeves. Plates shall be installed in all occupied areas.

2.7. FLANGES AND UNIONS

- A. Provide sufficient flanges or screwed unions in equipment piping to facilitate taking down of piping in easily handled sections at any future time. Sheet packing shall be used on flanged unions and flanged connections.
- B. Bronze to iron unions satisfactory up to 2 inches size.

2.8. DISSIMILAR METALS

- A. Do not use dielectric unions to connect piping of dissimilar metals.
- B. Provide gaskets between flanges at connections between dissimilar metals.

2.9. PIPE SIZE

- A. Pipe sizes indicated on the drawings are the minimum sizes required for system hydraulic performance. If the pipe size indicated is not readily available the Contractor shall provide the next larger pipe size available, including valves, fittings and other pipe components at no additional cost to the Owner.

PART 3. EXECUTION

3.1. INSTALLATION

- A. Install all items specified in accordance with the manufacturer's written instructions.
- B. Cleaning of Piping and Equipment:
 - 1. After piping is erected and hydrostatically tested, all piping systems shall be cleaned of all mill and welding scale, oil, corrosion, and construction debris by a pipe cleaning specialist. Systems shall be flushed clean and filled ready for service, immediately after cleaning. Do not operate pumps or equipment, or sterilize the potable water system until millscale and debris has been removed from the respective system and system has been flushed.

END OF SECTION 15050

**SECTION 15060
PIPE & PIPE FITTINGS**

PART 1. GENERAL

1.1. SECTION INCLUDES:

- A. This Section shall supplement all Division 15 Sections of these Specifications, and shall apply to all phases of the Work specified, shown on Drawings, or required for complete installation of mechanical systems for this Project.
- B. Install all piping as specified, indicated, or as necessary for complete installation of piping within the building.
- C. Related Work Specified Elsewhere:
 - 1. Piping Supports and Hangers: Section 15140, PIPING SUPPORTS, HANGERS AND ANCHORS.
 - 2. Section 15410, PLUMBING PIPING
 - 3. Section 15510, HVAC PIPING

1.2. QUALITY ASSURANCE

- A. Welding:
 - 1. All welding shall be done in accordance with the welding procedures of the National Certified Pipe Welding Bureau, conforming to requirements of the ASME Boiler and Pressure Vessel Code (Section IX) or the ASA Code for Pressure Piping. No welder shall be employed for the Work who has not been fully qualified under the above specified procedure and so certified by a member of a local chapter of the National Certified Pipe Welding Bureau or similar locally recognized testing authority. Do not perform any Work on the project or off-site fabrication of piping without first submitting this certification for each welder. The Owner reserves the right to require the recertification of any welder who has an excessively high weld failure rate. The Owner shall be the sole judge of what defines an excessively high weld failure rate.
 - 2. Welds shall be wire brushed after completion, coated with rust inhibitor paint and on galvanized pipes, given two coats of cold applied galvanizing compound and one coat of aluminum paint.
- B. HVAC system piping shall meet IMC – 2009 requirements and plumbing piping shall meet UPC – 2009.

1.3. PIPE SIZE

- A. Pipe sizes indicated on the drawings are the minimum sizes required for system hydraulic performance. If the pipe size indicated is not readily available the Contractor shall provide the next larger pipe size available, including valves, fittings and other pipe components at no additional cost to the Owner.

PART 2. PRODUCTS

2.1. MATERIALS

- A. Galvanized steel and black steel pipe and fittings for steel pipe:
 - 1. Steel pipe -Standard Weight:

Size Diameter Inches	Manufacturing Methods	Wall Thickness	ASTM	
			Spec	Grade
1/8 thru 10	Welded or Seamless	Schedule 40	A-53	A or B
Pipe Diameter (ins)	3/4" to 1"	1-1/2" to 2-1/2"	3" to 4"	5" and up
Pipe Wall Thickness (ins)	0.133"	0.203	0.232"	0.365"

- 2. Fittings for use with steel pipe:
 - a. When threaded fittings made of grey cast iron, malleable iron, and ductile iron are specified to be galvanized, hot dip galvanize each fitting before cutting threads.
 - b. Grey Cast Iron Fittings: Furnish standard weight fittings free of sand holes and imperfections, with clean American Standard taper pipe threads,

complying with Fed. Spec. SS-P-501, ANSI Standard B16.4. Material shall conform to ASTM A126, Class B. Furnish 125 lb. class.

- c. Malleable Iron Fittings: Furnish 150 lb. class with clean American Standard taper pipe threads complying with ANSI Standard B16.3. Materials shall conform to ASTM A197.
- d. Ductile Iron Fittings: Furnish 300 lb. S.W.P. class with clean American Standard taper pipe threads and comply with ASTM A395.
- e. Welding fittings: Furnish factory made fittings as set forth in and dimensioned in ANSI B16.9. Match wall thickness of fittings to steel pipe wall thickness specified, hereinbefore. Fittings shall conform to ASTM A106, Grade B. Short radius elbows and other fittings not meeting ANSI B16.9 shall not be used. Weldolets shall be manufactured and installed in accordance with ANSI B16.9 and ANSI B31.1. Thredolets shall be in accordance with ANSI B16.11. Fishmouth type fittings and mitered (built-up) fittings are unacceptable.

B. Copper piping, tube and fittings for copper tube:

- 1. Copper water tube and piping and fittings for pressure piping for pressurized water (domestic hot and cold, geothermal loop chemical mixture) and pressurized drain lines:
 - a. For all buried piping, furnish seamless copper water tube conforming to requirements of ASTM B88 in weight K, L or M and temper annealed or drawn as specified. Copper domestic water tube shall have a weight of not less than Type K for underground installations and Type L or M for above ground installations.
 - b. Fittings for copper water tube:
 - (1) Wrought copper fittings: Furnish wrought copper solder joint, pressure fittings conforming in all respects to ANSI B16.22 and same weight as pipe.
 - (2) Cast bronze fittings: Furnish cast bronze solder joint pressure fittings conforming in all respects to ANSI B16.18 and same weight as pipe.
 - (3) Brazolets shall be high silicon bronze conforming to ASTM B283 in sizes 2 inches and smaller, and conforming to MIL-B-16541 in sizes 2-1/2 inches and larger.
 - (4) Copper drainage tube and fittings (gravity and pressurized condensate drains):
 - (a) Copper tube for underground drainage and vent piping shall have a weight of not less than that of copper drainage tube Type L, and copper tube for above ground drainage and vent piping shall have a weight not less than copper drainage tube Type M.
 - (b) Fittings for copper drainage tube:
 - (i) Cast bronze drainage fittings: Comply with ANSI B16.23, with solder joints.
 - (ii) Wrought copper drainage fittings: Comply with ANSI B16.29 with solder joints for wrought copper and wrought copper alloy drainage fittings.
- 2. Piping under floors shall not have any joints in it. Underfloor copper piping shall be taken from single coil.
- 3. Contractor may use type compression joints for copper tubing and piping systems if approved for this by Authority Having Jurisdiction.

C. Plastic piping :

- 1. Subject to the authority having jurisdiction, above and below-grade plastic piping applications may be utilized for this Work as follows.
- 2. Non-pressure pipe and fittings above grade (indoors and gravity drains):

- a. Polyvinyl Chloride PVC (DWV): Pipe and fittings shall conform to ASTM D2665 with factory-attached joints, solvent cemented coupling, Schedule 40 service weight. Conform to UPC.
- b. Underground plastic drainage piping shall comply with requirements specified in Section 15410, "Plumbing Piping."
3. Pressurized piping, domestic water pressure pipe and fittings above grade (indoors):
 - a. Chlorinated Polyvinyl Chloride (CPVC): Pipe, tubing and fittings if used for systems allowed by IMC and UPC shall conform to ASTM D2846 and ASTM F441, 160 psi working pressure, SDR 11, (CPVC 4120). Pipe fittings shall be tapered socket type joints per ASTM F438/439. Transition fittings may be threaded if required per ANSI B2.1. If threaded are required seal threads with teflon tape. Installation shall be in conformance with IAPMO Standard IS20-89. Solvent cements shall comply with ASTM F493. CPVC piping and connections shall be suitable for deflection-free and leak-free operation up to 180°F. at the working pressure. Piping sizes up to 2 inches are acceptable in Schedule 40.
 - b. If used for piping over 2 inches, provide Schedule 80 CPVC pipe and threaded fittings.
 - c. If used for heat pump loop piping, provide Schedule 40 PVC with solvent welded fittings regardless of size. **Do not** provide threaded fittings in the heat pump loop chemical water system. **Do not** pressure test PVC piping inside building with air. PVC piping shall be used only for systems not exceeding 130F whether constant or intermittent conditions. Provide certification that the PVC piping supplied is suitable for the operating pressures and temperatures.
 - d. PVC piping shall be suitable for the chemical, glycol/water mixture specified for the geothermal heat pump system.
 - e. Cross-linked polyethethylene (PEX) plastic tubing may be used for the heat pump loop piping, inside the building in accordance with International Mechanical Code requirements. Joints in the PEX shall be socket or butt welded. Mechanical joints if specifically required shall comply with International Mechanical Code. Refer to Section 15031 for additional joint requirements for PEX heat pump loop piping.
 - f. PEX piping and PEX metal insert or compression fittings may be used for domestic hot and cold water under requirements specified in the Uniform Plumbing Code.
 - g. **Do not use CPVC for any part of the heat pump loop system.**
 - h. Contractor shall submit plastic piping materials proposed with temperature, pressure and chemical resistance characteristics.

PART 3. EXECUTION

3.1. PREPARATION

- A. Piping and Fittings: Ream all pipe to full inside diameter after cutting and thoroughly clean before erection.

3.2. INSTALLATION

A. General:

1. Run all piping as direct as possible, avoiding unnecessary offsets and conceal piping in finished rooms unless shown or specified otherwise. Arrange pipe lines to give ample room for the pipe insulation.
2. Make connections between new Work and existing Work by using specials and fittings to suit the actual conditions.
3. Make tee connections with standard tee fittings for full size branches. For reduction branches use reducing tees or weldolets and thredolets for steel pipe and brazolets for copper pipe.

4. Install underground piping in conformance with Sections 15014 and 15015. Repair any sidewalks, curbing or paved playgrounds. Install underground PVC piping in accordance with ASTM D2321.
5. Unprotected mill finished black or galvanized steel piping shall not be used for any underground direct-buried applications for this Project. Direct buried metal piping shall have the corrosion protection coating applied on the outer surface.

B. Pipe Joints:

1. Threaded Joints:

- a. Joints in threaded piping shall be made only with teflon tape or with a sealing compound applied on male threads only. Ends of pipes shall be reamed out before being made up into fittings.
- b. Joints in threaded steel pipe shall conform to the American National taper pipe thread, ANSI B2.1. All burrs shall be removed, pipe ends shall be reamed or filed out to size of bore, and all chips shall be removed. Pipe joint compound shall be used only on male threads. All-thread nipples shall not be permitted.
- c. Threaded joints between ferrous and non-ferrous piping shall utilize dielectric insulating couplings.
- d. For branch fittings in piping 2-1/2 inches and smaller, use straight size of reducing tee. When branch is smaller than header, a nipple and reducing coupling or swaged nipple may be used.
- e. With Schedule 80 or heavier plastic pipe, use threaded joints. Provide threads with sharp, clean pipe dies and teflon thread tape. Make joints in strict accordance with the plastic pipe manufacturer's recommendations.

2. Solvent Weld Joints:

- a. Solvent weld joints shall only be suitable for Schedule 40, PVC and CPVC plastic pipe, or lighter.
- b. Joints in PVC and CPVC plastic pipe shall be made with fittings by either solvent welded or fusion welded connections, insert fittings, and metal clamps and screws of corrosion resistant material, or threaded joints according to accepted standards.

(1) When PVC and CPVC is joined to another material by the use of threads, it shall be done by the use of proper male and female threaded adapters. Use only teflon tape or lubricant seal material recommended by the manufacturer. Threaded joints shall not be over-tightened. After hand tightening the joint, one-half to one full turn with a strap wrench will be sufficient. When PVC DWV is jointed to a cast iron spigot end of Schedule 40 (U.S. Standard steel pipe or copper tube, and where outside diameter of the two pipes and/or fittings to be joined is the same, pipes may be joined with an acceptable elastomeric sealing sleeve and stainless steel clamp, clamping screw, and housing.

3. Solder / Brazed Joints:

- a. Prior to making joints, cut pipe square and ream to full diameter. Clean exterior of pipe and socket. Apply a thin coat of suitable fluxing compound to both pipe and socket, and fit parts together immediately.
- b. Heat assembled joint only as required to cause the solder to flow. Run the joint full, slightly beaded on the outside, and wipe to remove excess solder.
- c. Use silver brazing alloy or Sil-Fos on underground piping. Use 95-5 solder on all other nonpotable water piping. For potable water piping, use only lead-free solder.
- d. Joints in copper drainage tube shall be soldered or brazed using acceptable fittings. Surfaces to be soldered shall be cleaned bright. The joints shall be properly fluxed and made with solder. Joints shall be made with lead-free 95-5 tin-antimony solder, Stay-Brite Solder by J.W. Harris Co., Inc. or by cadmium free brazing.

- e. The use of 50-50 solder will not be permitted on this Project.
- 4. Welded Joints:
 - a. Make welded joints as recommended by the ANSI standards.
 - b. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. Do not use mitered joints.
 - c. For branch connections on piping 3 inches and larger. When branch size is the same as header size, use welding tee. Use a weldolet when the branch is smaller than the header. For threaded branch connections, use 3000-pound full couplings welded to header.
- 5. Flanged Joints:
 - a. Prior to installation of bolts, accurately center and align flanged joints to prevent mechanical prestressing of flanges, pipe and equipment. Align bolt holes to straddle the vertical, horizontal or north-south centerline. Do not exceed 3/64 inch per foot inclination of the flange face from true alignment.
 - b. Use flat-face companion flanges only with flat-faced fittings, valves or equipment. Otherwise, use raised-face flanges.
 - c. Install proper gaskets, suitable for intended service and factory cut to proper dimensions. Secure with a suitable gasket cement.
 - d. Use ANSI nuts and bolts of galvanized, black or stainless steel to match flange material. Use ANSI 316 stainless steel nuts and bolts underground, outdoors, or in wet locations. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.
 - e. Use carbon steel flanges conforming to ANSI B16.5 with materials conforming to ASTM A105, Grade II or ASTM A108, Grade II. Use slip-on type flanges on pipe only. Use welding neck type flanges on all fittings. Weld slip-on flanges inside and outside.
 - f. Keep flange covers on equipment and shop-fabricated piping until ready to install in system.
- 6. **Grooved Piping systems are not acceptable for any system covered under these specifications, except for where specifically noted for the geothermal loop heat pump system.**
- 7. PEX tubing for domestic water piping shall be joined using joints approved by the Uniform Plumbing Code and recommended by the pipe manufacturer.
- 8. The Contractor may provide compression joints of copper piping for geothermal loop, and domestic water if approved by the authority having jurisdiction.
- C. Pipe Fabrication and Installation:
 - 1. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the maximum access to various equipment parts for maintenance.
 - 2. Do not cut or weaken any structural member.
 - 3. Cut all pipes accurately to measurement determined at the site. After cutting pipe, ream it to remove burrs.
 - 4. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make all changes in direction. Field bending and mitering are prohibited. Make all connections to equipment using flanged joints or unions. Make reducing connections with reducing fittings only.
 - 5. Welding:
 - a. Weld and fabricate piping in accordance with ANSI Standard B31.9, latest edition, Code for Service Piping for heat pump loop. Use ANSI B31.9 for welding other piping. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards.

- b. Align piping, fittings and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
 - c. Do not permit any weld to project within the pipe in excess of 1/16 inch so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
 - d. Remove dirt, scale and other foreign matter from inside piping before tying in sections, fittings, valves or equipment.
6. Offsets and Fittings:
- a. Because of the small scale of drawings, the indication of all offsets and fittings is not possible. Carefully investigate the structural and finish conditions affecting the work and take such steps as may be required to meet such conditions.
 - b. Install all piping close to walls, ceilings and columns so piping will occupy the minimum space. Provide proper space for covering and removal of pipe, special clearances, and for offsets and fittings.
7. Nondestructive examination (NDE) of all welds shall be conducted by the Contractor's testing agency. It is the intent of this Specification to require only the minimum level of NDE required by ANSI B31.9 for the service specified. Higher levels of NDE such as radiograph, liquid penetrant or magnetic particle examination shall be used only in the following cases.
- a. If a weld is not totally accessible for a visual examination, the higher level of NDE shall be used.
 - b. If the Contractor challenges a specific weld rejection using the visual observation method, such a weld shall be examined using another NDE method.
8. This Contractor shall grind out and repair any rejected weld, and shall be responsible for the cost of any re-tests. The re-test method shall be the same as was used for finally rejecting the weld. For example, if a weld was initially rejected using a visual examination but such a rejection was challenged and the weld was subsequently rejected using radiography, the repaired weld shall be tested using radiography.
9. Underground piping
- a. Outside of building for piping 2 ½ inches and larger diameter- black wrought iron and black steel: black wrought-iron and
 - (1) black steel piping shall be protected against corrosion by an approved pipe wrapping.
 - b. Openings into buildings: Voids around piping passing through concrete or masonry floors or walls shall be appropriately sealed at the opening into the building; sleeves shall be provided at such openings.
 - c. For piping 2 inches and smaller diameter use Type K tubing, and to the greatest extent possible use copper tubing from a single coil to eliminate underground pipe joints. Braze necessary underground joints in copper piping.

3.3. ADJUSTMENT AND CLEANING

A. Cleaning of Piping and Equipment:

- 1. After piping is erected and hydrostatically tested, all piping systems shall be cleaned of all mill and welding scale, oil, corrosion, and construction debris by a pipe cleaning specialist. Systems shall be flushed clean and filled ready for service, immediately after cleaning. Do not operate pumps or equipment, or sterilize the potable water system until millscale and debris has been removed from the respective system and system has been flushed.
- 2. Flush supply pipe systems forward (normal direction of flow to pump suction). Provide large (temporary) blow-offs or drains in system low points, at pumps and open ends high to admit air. Fill systems to open high ends and then open low

drains for flushing action on return and on supplies. Prevent millscale and debris from entering coils, tanks, equipment, and control valves. Provide temporary strainers in all systems located at pump suction, control valves and other places as indicated during cleaning operations. Strainers shall have 1/10 inch mesh perforations and shall be removed after systems are flushed, after which the permanent strainers shall be installed. Isolate or adequately protect all equipment and parts which would be susceptible to damage due to foreign materials during the cleaning process.

3. Entire non-potable piping systems and related equipment in the heat pump loop shall be cleaned by forced high velocity circulation of a solution of non-corrosive chemical cleaner and non-foaming detergent, followed by a continuous flush with clear, clean domestic water until residual alkalinity of the water leaving systems is 300 ppm or less. Pumps shall not be operated until system is clean.
4. Automatic devices which can become clogged during the cleaning process shall be disconnected and shall not be connected permanently until the cleaning process is complete.
5. All strainers, automatic valves, pump seals, vents, etc., and other parts shall be cleaned.
6. For all systems the system pump shall be turned on for a few minutes at low speed or valved back to half flow. This action will move most air to the system high points. With the system pump off, the vents shall be opened and the fill pump shall be started again. This procedure shall be repeated a few times and when most of the air is eliminated, the valves shall be open and the system pump shall be run at full flow.
7. The system's air eliminator shall be used to remove the final amounts of air. Once all the air is removed, the fill pump shall be run until the systems expansion tank is at the proper level and the system is at the proper working pressure (usually 5 psi at high point).
8. The Contractor shall vent the systems during fill. The air has to come out of the system to let the fluid in. Before the fill, check to make sure all control valves are in the open position. During the fill, periodically check the valves. To ensure no loss of fluid, close them off as the system fills up. Provide continuous automatic vents at the piping system high points to assist in bleeding trapped air during initial system use. The automatic vents shall be provided with a shut valve or cock in the discharge piping. The automatic vents shall discharge into a container that will collect system fluid (chemical water mixture). Contractor shall close manual shutoff after venting is finished.
9. Add the specified chemicals after the system piping has been cleaned, flushed and filled.

END OF SECTION 15060

**SECTION 15100
VALVES****PART 1. GENERAL****1.1. SECTION INCLUDES**

- A. This Section includes all valves within the mechanical systems inside and outside the building if the valves are not specified elsewhere.
- B. Related Work Specified Elsewhere:
 - 1. Automatic control valves are specified in Section 15950, CONTROLS.

1.2. QUALITY ASSURANCE**A. General:**

- 1. All gate valves shall be designed for repacking under pressure when fully opened, and shall be equipped with packing suitable for intended service. When valve is fully opened, back seat shall protect the packing and stem threads from fluid.
- 2. Bronze Valves:
 - a. Valves with steam pressure rating of 125 psig or 150 psig shall have pressure containing parts of a material conforming to ASTM B62.
 - b. Bronze gate and check valves shall conform to Manufacturer's Standardization Society (MSS) of the valve and fittings industry SP-80.
- 3. Iron Body Valves:
 - a. Pressure containing parts of valves shall be of material conforming to ASTM A126, Grade B.
 - b. Face-to-face and end-to-end dimensions shall conform to ANSI B16.10.
 - c. Gate valves shall conform to MSS SP-70.
- 4. Valve stems shall be copper silicon alloy conforming to ASTM B371 or ASTM B584.
- 5. Wheel handles shall be non-heating style cast from malleable iron with a corrosion resistant epoxy or enamel finish, or commercial aluminum.
- 6. Butterfly valves shall conform to the requirements of MSS SP-67.
- 7. Check valves shall operate equally well in horizontal or vertical positions.
- 8. All valves shall be full line size unless otherwise shown on the Drawings.
- 9. Provide valve stem extension of length to suit layout and depth for valves required for specified duty.
- 10. Do not use gate valves unless specifically indicated in a specification section. Use ball valves as specified for 2 inches and under, and butterfly valves for sizes over 2 inches. Refer to drawings and Section 15031 for geothermal loop header system valve requirements which require butterfly valves for piping 2 inches and less.

1.3. SUBMITTALS

- A. Submit valve shop drawings for all valves to be supplied.

PART 2. PRODUCTS**2.1. MATERIALS****A. General:**

- 1. Insofar as possible, all valves of the same type shall be of the same manufacturer. All swing check valves as a group shall be of the same manufacturer.
- 2. All valves 2 inches and smaller shall be threaded and have bronze bodies, unless specifically indicated otherwise.
- 3. All valves 2-1/2 inches and larger shall be iron body bronze mounted (IBBM) type and shall be flanged.
- 4. All valves 4 inches and larger mounted in excess of 7'-0 inches above the floor in mechanical rooms shall be equipped with chain operators. Extend chains to within 6'-6 inches of floor.
- 5. Mark each valve at the factory with the following minimum information, engraved, stamped, or cast on each valve or metal tag, permanently attached to the valve.

- a. Manufacturer's Name.
 - b. Catalog or Figure No.
 - c. Size and Pressure Class.
 - d. Arrows to indicate direction of flow on check valves.
 - e. Underwriters' Laboratories (UL) approved valves shall bear the Underwriter's label Permanently attached to the valve body.
6. It is understood that valve manufacturers change model numbers from time to time. The Contractor shall supply current valves that have equal characteristics to the old model numbers specified in such an event.
- B. Gate Valves: (Do not use gate valves unless specifically called for on the drawings or in a technical section.) Following are specifications for the cases where gate valves are required by the construction documents.
1. Class 125:
 - a. General: Furnish valves 12 inches and smaller designed for 125 psig steam and 200 psig non-shock water, oil and gas working pressure
 - b. Size 2 inches and Smaller:
 - (1) Furnish bronze valves with screwed-in bonnet, non-rising stem, solid wedge disc, and threaded ends.
 - (2) Manufacturers and Figure Numbers:
 - (a) Crane 438
 - (b) Hammond 1B-645
 - (c) Jenkins 992
 - (d) Kennedy 427
 - (e) Lunkenheimer 2129
 - (f) Milwaukee 105
 - (g) Nibco T-113
 - (h) Powell 507
 - (i) Stockham B-103
 - (j) Walworth 4
 - c. Size 2-1/2 inches and Larger:
 - (1) Furnish iron body bronze mounted (IBBM) valves with bolted bonnet, non-rising stem, solid wedge disc, flanged ends, and renewable seat rings.
 - (2) Manufacturers and Figure Numbers:
 - (a) Crane 461
 - (b) Hammond 1RI138
 - (c) Kennedy 058
 - (d) Lunkenheimer 1428
 - (e) Milwaukee F2882
 - (f) Nibco F-619
 - (g) Powell 1787
 - (h) Stockham G-612
 - (i) Walworth 8719F/719F
- C. Check Valves:
1. Water, Oil, and Steam, Size 2 inches and Smaller:
 - a. Furnish swing check valves designed for 200 psig steam and 400 psig nonshock water, oil, and gas working pressures. Valves shall have renewable discs and side plugs and regrindable, integral seats. Discs shall be renewable and seats reground without removing valves from the line.
 - b. Manufacturers and Figure Numbers:
 - (1) Crane 36
 - (2) Hammond 1B-949
 - (3) Jenkins 762-A
 - (4) Kennedy 444
 - (5) Lunkenheimer 554Y
 - (6) Milwaukee 508

- (7) Nibco T-476-B
 - (8) Powell 560Y
 - (9) Stockham B-345
 - (10) Walworth 3420
 - 2. Size 2-1/2 inches and Larger:
 - a. Water Check Valves:
 - (1) Valves shall be silent type spring loaded of the double door or wafer style. Valves shall be designed for 125 psig nonshock water working pressure at 250°F.
- D. Butterfly Valves:
- 1. Furnish valves designed for 150 psig and 250°F. water service. Valves shall have extended necks. Operator shall be 10-position lever lock for sizes 2 inches through 5 inches and totally enclosed and sealed worm gear actuators with 4-arm or wheel handle for sizes 6 inches and larger. Valves shall be bi-directional suitable for drop-tight shut-off at full rated pressure with flow in either direction.
 - 2. Materials:
 - a. Body: Cast or ductile iron.
 - b. Disc: Bronze, aluminum bronze, or stainless steel.
 - c. Stem: Type 416 stainless steel.
 - d. Seat: Ethylene Propylene Diene Terpolymer (EPDM).
 - 3. Manufacturers and Model Numbers:
 - a. Lug Type: Valves shall be full lug type drilled and tapped - Sizes 2 inches through 12 inches:

(1) Centerline LT	Jenkins 642	Nibco NL-082
(2) Crane 24N	Keystone 122	Powell 3100
(3) DeZurik 660L	Lunkenheimer 4717	Stockham LG7
(4) Hammond 3820	Mission 3100	
 - b. Wafer Type: Sizes 2 inches through 12 inches:

(1) Centerline A	Jenkins 632	Nibco WL-082
(2) Crane 22F	Keystone 100 or 228	Powell 3000
(3) DeZurik 660W	Lunkenheimer 4537	Stockham LG5
(4) Hammond 3800	Mission 3000	
(5) Apollo	141/143 Series	
- E. Relief Valves:
- 1. Water:
 - a. Hydronic Heating and Cooling Systems (Heat pump loop):
 - (1) Low Pressure: Provide setting as indicated on the drawings.
 - (a) Manufacturers and Model Numbers:
 - (i) Bell and Gossett A3
 - (ii) Taco 333
 - (iii) Apollo
- F. Ball Valves:
- 1. General: Valves shall be non-blowout stem design. Quarter turn of handle shall fully open or close valve. Handle position shall indicate whether valve is open or closed. Handle stops shall be a permanent, integral part of the body. Provide 3 inches stem extension on all ball valves to allow for installation of 2 inches of insulation on ball valve.
 - 2. Size 2 inches and Smaller:
 - a. Valves shall be standard port, 2-piece construction with screwed ends. Valves shall be designed for 400 psig WOG working pressure at 150°F.
 - b. Valves shall have bronze or brass body, chromium plated or stainless steel ball, steel handle with vinyl grip, and replaceable teflon seats.
 - c. Manufacturers and Figure Numbers:
 - (1) Apollo 70-100
 - (2) Crane 2330
 - (3) Hammond BV711-T

- (4) Jamesbury 300
 - (5) Jenkins 901-A
 - (6) Lunkenheimer 708HST
 - (7) Marpac B780T
 - (8) Nibco T-585
 - (9) Powell 5220
 - (10) Stockham S-214
 - (11) Watts G4000
3. Size 2-1/2 inches and Larger:
 - a. Valves shall be standard port, ANSI Class 150 with flanged ends. Valves shall be designed for 250 psig working pressure at 150°F.
 - b. Valves shall have steel body, chrome or nickel plated steel or stainless steel ball, replaceable teflon seats, and steel stem and handle.
 - c. Manufacturers and Figure Numbers:

(1) Apollo 88-100/200	Jamesbury 5150	Lunkenheimer
713LT		
(2) Crane 941-TF	Jenkins 1001	Marpac 400/470
- G. Domestic water (Potable water valves)
1. Acceptable manufacturers:
 - a. Watts is the design basis for the project.
 - b. The Contractor may submit for review and acceptance, equivalent valves manufactured by the following.
 - (1) Conbraco/Apollo
 - (2) Milwaukee
 - (3) Powell
 - (4) Crane
 - (5) Walworth
 2. The Design Professional shall be the sole judge of the equivalency of the valves submitted when compared to the Watts design bases.
 3. All valves shall be of the same manufacturer unless otherwise specified in this Section or on the drawings.
 4. Figure numbers in valve schedule based on Watts, unless noted otherwise.
 5. Domestic Water Valve Specifications And Schedule.
 - a. Gate valves shall not be used.
 - b. Globe valves shall not be used.
 - c. Ball Valves
 - (1) Ball valves shall be suitable for use in potable water systems and shall be FDA approved for use in food contact applications.
 - (2) Ball valves smaller than 2 inches shall be bronze construction with screwed ends.
 - (3) Ball valves 2 inches and larger shall be cast iron body with flanged ends. All interior and exterior surfaces of the cast iron valves shall have a double coated, electro statically applied, heat fused epoxy coating. Flanged valves shall have two priced body construction.
 - (4) Provide 3 inches stem extension to allow for 2 inches of insulation.
 - (5) Provide a memory stop for each ball valve.
 - (6) Provide quarter turn shut off and full open capability.
 - (7) Provide 304 stainless steel ball in each valve.
 - (8) Flanged valves shall comply with face to face dimensions of ANSI B16.10 for Class 125 cast iron flanged gate valves. The dimensions and drilling of the end flanges shall conform to the American cast iron flanges standard, Class 125, ANSI B16.1.
 - (9) The valves shall have a 140°F temperature rating and a 200 psi pressure rating or greater.
 - (10) Valves shall provide positive shutoff.

(11) Valves for service under 2 inches shall be Watts Series B 6800, quarter turn shut off.

(12) Valves for service 2 inches and larger shall be Watts Series G-4000-FDA.

H. Pressure/temperature ratings: valves shall have pressure and temperature ratings equal to or greater than the piping system containing the valves.

I. Refer to other technical sections for special system valve requirements.

PART 3. EXECUTION

3.1. INSTALLATION

A. Install all valves in accordance with manufacturer's instructions and as shown on Drawings.

B. Flanged valves shall be installed between flanges.

C. Valves installed in insulated domestic cold, hot and re-circulating water, and heat pump loop systems shall have extended handle shafts to provide at least 1/2 inch clearance between the handle and insulation outer surface to afford operation.

D. All valves shall be installed such that all handles are accessible, and that handles may be operated from full open to full closed position without obstruction.

3.2. ADJUSTMENT AND CLEANING

A. Valves and stops shall be adjusted, packed, and repacked as may be required to eliminate leaks and produce proper flow.

END OF SECTION 15100

**SECTION 15101
TESTS - PIPING SYSTEM**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping tests for all systems as follows:
 - 1. Sanitary sewer piping.
 - 2. Heat pump loop within the building.
 - 3. Domestic potable water (cold, hot, hot water re-circulating).
 - 4. Geothermal loop field piping, external to the building heat pump loop.
- B. Additional tests may be specified in other sections. These shall be performed in addition to those specified in this section.
- C. Should governing bodies require tests over and above those specified, they shall be performed and certified for approval by such governing bodies or agencies.
- D. Perform additional tests as may be required by City of Stuart and Director of Public Works for potable water and sewer.
- E. Provide certified test reports for all systems.
- F. Maintain permanent record of each test indicating system, or portion of system tested, date of test, results and signature of witness.

1.2 EQUIPMENT

- A. Provide all devices, equipment and gases necessary to make tests required. Devices installed in the work shall not be used for test purposes.
- B. Materials shall be subjected to standard tests by manufacturer before shipment.

1.3 GENERAL REQUIREMENTS

- A. Make tests during installation and after completion. Tests shall be made at no additional cost to the Owner.
- B. Piping concealed in building construction, chases, etc., shall be tested before being concealed. Contractor failing to make such tests must assume all costs of removing and replacing defective piping and shall pay all costs of cutting and repairing building construction made necessary by this neglect to end of guarantee period.
- C. Make test prior to insulating piping. Contractor failing to make tests prior to insulating of piping must assume all costs of removing and replacing insulation on defective piping.
- D. Make hydrostatic tests with cold water. The minimum duration shall be four hours unless specifically indicated otherwise. Do not use air for pressure testing where cold water is specified as the test medium.
- E. Advise the Design Professional and Owner's representative one work day prior to testing so the Design Professional may witness the test if he chooses. Contractor shall be responsible for correct testing, observation of results and corrections necessary. The Contractor shall keep written record of test date, time, pressure, duration, results and obtain signature of witness.
- F. Provisions shall be made so that every item may be thoroughly inspected, and in no case shall any part of construction be obscured.
- G. Do not apply test pressures to a hot valve. In event such testing is necessary, install temporary block ahead of valve. Final test of connection against hot valve shall be by examination of work under service pressure.
- H. Any device connected into system which cannot assume the test pressure shall be disconnected and protected from damage.
- I. All parts of system under test must be under constant supervision with authority to bleed off excess pressure that may develop. No test shall remain on work unless continuously attended. Use care so that excess pressure does not develop because of temperature changes.
- J. Work shall be completely leakfree at any joint, fittings, accessory, or attachment. If repairs are necessary, re-test work after correction. Correct defects manifested by these tests before proceeding with other work.
- K. Fluids shall circulate and flow freely without noise, vibration or hammer on either manual or automatic control, with no evidence of leaks, trapping or binding.

- L. Mechanical and Electrical equipment shall operate satisfactorily at specified capacity without noise, vibration, overheating or evidence of misalignment or insecure mounting.
- M. After welding, all welded piping shall be subjected to a hydrostatic test of at least 150% of design pressure, but in no case less than 60 psig.

1.4 CERTIFIED TEST REPORTS

- A. For each system or portion of system tested, provide a certificate testifying that the system was tested as specified and provide the following data:
 - 1. Identification of system or portion of system tested referencing specific equipment connected to system.
 - 2. Date tested.
 - 3. Test pressure and duration of test.
 - 4. Recorded test pressure at end of test.
 - 5. Media used for testing.
 - 6. List necessary repairs made before the system passed the leak test.
 - 7. Signature of testing contractor.
 - 8. Signature of witness (must be a representative of the General Contractor, the Design Professional or the Owner)
 - 9. Other data as required by the system specification.
- B. Submit the individual test reports to the Design Professional for review within two weeks of successfully completing the individual tests.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 DOMESTIC WATER SYSTEMS AND PRESSURIZED SANITARY SYSTEM

- A. Design temperature and pressure:
 - 1. Temperature: 120°F.
 - 2. Pressure: 80 psig
- B. Hydrostatically test at working pressure of system but at not less than 80 psig minimum, 15 minute duration. Test medium shall be taken from a potable water source. Test in accordance with the Uniform Plumbing Code.
- C. After test blow clean with potable water, leave lines clean of all sediment and debris.
- D. Sterilize all new potable water lines after successful completion of piping tests. Sterilization shall be performed in accordance with method specified in SECTION - Plumbing Piping.

3.2 SANITARY SEWER – GRAVITY DESIGN

- A. Inspect all new lines over entire length for obstructions with illumination and by rodding entire length.
- B. Hydrostatically test building work to maximum head of water possible by plugging outlet and filling system to maximum height as specified in the Uniform Plumbing Code.
- C. Keep infiltration into gravity sewers to minimum. Proof may be required by tests on completed project immediately after rain of sufficient intensity to saturate soil or by other means.
- D. Test gravity drain systems for gas and water tightness as specified in the Uniform Plumbing Code.
- E. All building sanitary sewers shall be tested even if not required by the City of Stuart.
- F. Work developing leaks shall be repaired or replaced at once.

3.3 OTHER PIPING SYSTEMS

- A. Test all piping systems not listed in accordance with systems manufacturer's requirements, or as specified in technical sections.
- B. In all cases, blow or flush all piping of all sediment and debris in an approved manner.
- C. Refer to specific Site Utility specification sections for additional tests required for these systems.

3.4 STRAINERS

- A. It shall be the responsibility of this section to install all strainers as may be required to properly protect all equipment from sediment or debris in the transported media that could damage such equipment.
- B. Where permanent strainers are not shown, temporary strainers are required for use during the start up period.

- C. This section must guarantee that no equipment or device will be damaged during the warranty period by any dirt, sediment, debris, transported through the piping system.
- D. This section shall be responsible for cleaning permanent strainers and removing temporary strainers from the systems after the testing specified has been satisfactorily completed. The permanent strainer shall be cleaned and the temporary strainers removed only after the Contractor receives specified permission to do so by the Design Professional.

3.5 HEAT PUMP LOOP INSIDE BUILDING

- A. Design temperature and pressure on heat pump loops inside the building:
 - 1. Pressure: 100 psig
 - 2. Temperature: 100°F.
- B. Maintain for not less than 30 minutes.
- C. After test, blow all piping clean with water. Leave lines clean of all debris and sediment.
- D. Special piping materials shall be tested as recommended by the manufacturer.
- E. Test the inside heat pump loop piping at the specified pressures even though the system relief valves and expansion tank relief valves are set significantly lower than the minimum test pressure. The individual heat pump coils shall be isolated from the system during the system overpressure tests. These isolated components shall be tested at the service pressure specified for each component.

3.6 HEAT PUMP EXTERNAL PIPING

- A. The outside of building heat pump loop piping shall be pressure and leak tested in accordance with Section 15031.
- B. This Contract shall be responsible for flow rate testing and balancing the geothermal loop field piping as specified in Section 15031.

END OF SECTION 15101

**SECTION 15120
PIPING SPECIALTIES**

PART 1. GENERAL**1.1. SECTION INCLUDES**

- A. This Section includes piping specialties complete.

1.2. SUBMITTALS

- A. Submit shop drawings for expansion tanks, air separator, strainers, pressure gages, thermometers, self-regulator control valve, test plugs (gage adapter), slipstream filters and air vents.

PART 2. PRODUCTS**2.1. MATERIALS**

- A. Air vents shall be installed on all coils, radiation and other points required for efficient operation of system.
1. Automatic vents:
 - a. Automatic vents shall be Dole No. 20SR, Spirotherm "Spirotap" quick air release, TACO air vent or Spirax/Sarco No. 15 disc type air vent for operating pressures to 20 psig, Sarco 13W or Armstrong 1-AV for operating pressures to 100 psig.
 - b. On high points in piping and where exposed to view, install automatic vents specified above. Route automatic vent drain line to nearest floor drain.
 - c. Vents on air and dirt separators shall be float actuated designed to purge free air from the system and provide positive shut-off at pressures up to 150 psig at a maximum temperature of 250°F. Vent shall be tightly sealed against loss of system water and prevent entrance of air in negative pressure situations. Vent shall be pilot operated for intermittent purging of free air at pressures up to 2 psig during normal system operation, and diaphragm operated for full capacity purging of free air at pressures between 2 and 150 psig.
 2. Manual vents: For vents on mechanical equipment.
 - a. Furnish air chambers at all high points in piping with air vent cocks fully accessible. Furnish air chambers with diameters same size as pipe and a minimum of 2 inches long except furnish same length as diameter for pipes larger than 2 inches. When air vent cocks on air chambers are not fully accessible, extend cocks with 1/4 inch copper water tube Type L as directed.
- B. Expansion tank:
1. General: Tanks shall be sizes as shown on Drawings, ASME constructed and stamped for 125 psi working pressure.
 2. Diaphragm type pre-pressurized tanks: tank shall be provided with an integral butyl rubber diaphragm which shall contain a sealed-in air cushion pre-charged to the minimum system pressure. Tank shall have an air charging valve and shall be designed to a maximum operating temperature of 240°F.
 3. Tank manufacturer shall be Amtrol, Bell and Gossett, Taco, John Woods Co., or Patterson.
 4. Relief pressure and fill pressure shall be as indicated on the drawings.
 5. Diaphragm shall be suitable for use with the specified heat pump loop chemical water mixture for the geothermal system.
- C. Refer to Section 15545 for dirt separators and the "Flow Center".
- D. Strainers:
1. Furnish "Y" type strainers throughout the job unless specifically noted otherwise. Furnish hot dip galvanized strainers in galvanized iron pipe.
 2. "Y" Strainers: Furnish one manufacturer throughout Project.
 - a. Strainers shall be designed for 125 psig minimum steam working pressure equipped with blow-off plugs and manufactured by Crane, Mueller Steam Specialty, Armstrong, Spirax Sarco, Apollo, Metraflex or Keckley.

Service	Size (inches)	Straining (Inches)		
		Coarse	Medium	Fine
Water	1/4 to 2	1/10	1/16	30 mesh
	2-1/2 to 4	1/8	1/16	3/64
	5 up	1/4	1/8	1/10

- b. Strainers 2 inches and Smaller: Furnish screwed ends, screwed bronze cap and gasket in sizes 1-1/2 inches and smaller and with a bolted cap on 2 inch size. Screens on water service shall be medium made of monel or Type 304 stainless steel. Furnish iron body strainers Mueller No. 251 FBC or 251 BC except furnish bronze strainers in all copper piping Mueller No. 351.
 - c. Strainers 2-1/2 inches through 12 inches: Furnish flanged ends, bolted iron cap and gasket. Screens on water service shall be medium in monel or Type 304 stainless steel. Provide Crane No. 989-1/2.
 - 3. Temporary Cone Strainers.
 - a. Provide temporary cone strainers to protect boilers, unit heaters, heat pumps permanent strainers, control valves, pumps and other devices during startup of new equipment and flushing of piping systems.
 - b. Provide temporary cone, basket and flat strainers.
- E. Unions:
- 1. All unions in steel pipe shall be 150 psig malleable iron, screwed, with brass to iron ground joints.
 - 2. All unions in copper pipe shall be cast bronze, wrought copper or wrought bronze, Class 125, with threaded or solder-joint tube ends.
- F. Pressure Gages:
- 1. General: Provide pressure gages manufactured by Trerice, AMETEK/U.S. Gage, Ashcroft, Winters Instruments or Weiss, with white dial and black scale, size 4-1/2 inch dial. Locate gages for easy reading. Install gages as shown on the drawings. Equip each gage with an integral or separate siphon and connect by means of a brass snubber pipe and fittings containing a shut-off cock.
 - 2. Water system pressure gages shall have a range to cover pumping head, as well as static head.
- G. Thermometers:
- 1. General: For remote thermometers, see Section 15950, CONTROLS.
 - 2. Thermometers in water systems. Furnish thermometers of the separable socket type, 9 inch scale, adjustable angle, red reading mercury manufactured by Trerice, Moeller, Winters Instruments or Weiss. Thermometers shall be mounted for convenient reading. Install stems longer than pipe diameters in pipe tee. Ranges shall be as follows:
 - a. Domestic hot and cold water 30°F. to 240°F.
 - b. Heat Pump 0°F. to 100°F.

- H. Different pipe materials - connection:
 - 1. Provide at all interconnections between piping systems of dissimilar material and at all connections of piping systems to equipment where piping and equipment are of dissimilar materials, the appropriate sizes of gaskets and flanged connections.

OUTSIDE DIAMETER OF PIPE OR COVERING	HEIGHT IN INCHES OF LABEL LETTER
3/4 inch to 2 inches inclusive	1/2 inch
2-1/2 inches to 6 inches	1 inch
8 inches and over	3 inches

- 2. Provide flanges with gaskets at these connections.
- I. Test Plugs:
 - 1. Provide 1/4 inch or 1/2 inch NPT test plugs of stainless steel at locations shown on Drawings. Plugs shall be capable of receiving either a temperature probe or pressure probe 1/8 inch O.D. Fittings shall have a valve core of nardel suitable for temperatures to 350°F., and shall be rated for zero leakage for pressure from 0 to 1000 psig.
 - 2. Provide test plugs manufactured by Peterson Engineering Company "Pete's Plug," or Sisco, or Omega.

- J. Piping Identification:
 - 1. Pipe coding shall consist of label legend, with coded color bands of 3/4 inches wide, 2 mil thick polyvinyl with directional arrows, of length equal to circumference of pipe or covering. Apply labels at 20 foot intervals. On short runs and complicated piping, apply as often as necessary for proper identification but not exceeding 10 feet apart. Coding shall be applied to all piping in mechanical rooms, accessible chases, above suspended ceilings and other accessible areas. They need not be coded in spaces that are not accessible.
 - 2. Color designation numbers shown in schedule below correspond to OSHA Standard colors.
 - 3. Label legend shall be placed on the bottom half of pipe, facing about 30 degrees downward toward either side. Where view from this angle on the floor is obscured by other pipe or objects, place label in the most visible position. All label lettering shall be with black paint.
 - 4. System of pipe marking labels manufactured by Seton Name Plate Corp., Brady Signmark Division, or Wilmington Plastics, Wilmington, Delaware, Brimar shall be used.
 - 5. Size of Stencil for Various Pipe Sizes:
 - 6. Piping labeling shall be applied prior to Contractor requesting a substantial completion checkout by the Design Professional. Piping system identification is critical to system checkout and trouble shooting.

7. Pipe Coding Schedule:

PIPING	LABEL LEGEND	BAND COLOR
<u>PLUMBING</u>		
Cold water (domestic)	CW	Green
Hot water (domestic)	HW	Green
Hot water re-circulating (domestic)	HWC	Green
Sanitary sewer gravity	SAN	Green
<u>HOT/CHILLED</u>		
Heat pump loop supply	HCS	Yellow
Heat pump loop return	HCS	Yellow

PART 3. EXECUTION

3.1. INSTALLATION

- A. Provide ball or butterfly isolation valves at each piece of equipment to provide for isolation of the equipment from its connected system. Locate strainers and valves as necessary to provide easy isolation and cleaning of strainers.
- B. Strainers shall be installed ahead of all automatic valves and elsewhere as indicated on Drawings. Provide a ball valve in the blow-off opening of each strainer. Provide cone strainer in return heat pump line from field.
- C. Unions shall be provided adjacent to each screwed type valve and shall be on the outlet side of valve.
- D. Install thermometers, gage adapters and gages for easy reading.
- E. Furnish piping accessories where shown and as necessary for complete installation of mechanical Work.
- F. Install filtration equipment in accordance with manufacturer's recommendations.

3.2. ADJUSTMENT AND CLEANING

- A. Valves and Specialties:
 - 1. All valves and specialties shall be adjusted to operate smoothly and without binding or leaking. All vents shall be tested and proven to open freely for passage of air.
 - 2. Expansion tanks shall be checked and proper water/air level adjusted and set.
 - 3. Locate strainers as necessary to allow easy cleaning.

END OF SECTION 15120

**SECTION 15140
PIPE HANGERS & SUPPORTS**

PART 1. GENERAL

1.1. SECTION INCLUDES:

- A. This Section includes piping supports complete for all piping systems except as otherwise specified.

PART 2. PRODUCTS

2.1. MATERIALS

- A. All hangers, supports, anchors, sway bracing and guides shall be in accordance with ANSI B31.1, B31.9 or applicable sections of the International Mechanical Code, and Uniform Plumbing Code. Do not hang or support piping from chains, straps, wire or perforated bar hangers or from ductwork.
- B. Dielectric Protection: Furnish acceptable protection or copper-plated hangers between all ferrous and nonferrous metal pipe and its hangers, clamps, sleeves and saddles on all water piping.
- C. Horizontal Piping Hangers:
 - 1. Provide one of the following types of hangers for horizontal piping manufactured by Grinnell or Carpenter and Patterson.
 - 2. All Pipe except Copper:
 - a. Except as otherwise specified hereinafter, provide clevis type, Grinnell Figure 260 or Figure 300 as required to keep the clevis nut outside the insulation, or split ring type.
 - b. At Contractor's option, provide adjustable swivel ring steel band hangers for piping 3 inches and below in lieu of clevis hangers, Grinnell Figure 69.
 - c. Where pipe exceeds maximum loading recommended for Clevis type hangers, furnish steel pipe clamp, Grinnell Figure 216.
 - d. Provide trapeze hangers where several pipes can be installed parallel and at the same level, and fabricate from structural steel shapes. Use roller chairs, Grinnell Figure 175, or pipe-roll stands, Grinnell Figure 271, where provision for expansion is required.
 - (1) Spacing shall not be farther than the closest interval required for any size pipe supported thereby, or as necessary to prevent damage or failure to the structure.
 - (2) When trapeze hangers are not shown, furnish shop drawings of installation where there is doubt of the structural capacity for concentrated loads.
 - 3. Copper Tubing Support:
 - a. Hangers Touching Pipe: Provide copper plated hangers, split-ring extension hanger, Grinnell Figure 138R.
 - b. Hangers on Outside of Insulation: Furnish same as specified for steel pipe.
 - c. Hangers for exposed to view piping shall be the split ring type extension type. Grinnell figure 138R.
 - 4. Floor Supports: Provide one of the following means of supporting horizontal piping from floor.
 - a. Where bottom of piping is less than 1'-6 inches above finish floor, furnish cast-iron pipe rests, Grinnell Figure 258, with pipe nipples to suit. Fasten to floor.
 - b. Where bottom of pipe is higher than 1'-6 inches above finish floor and/or where provision for expansion is required, furnish pipe-roll stands, Grinnell Figure 271, without vertical adjustment, or Grinnell Figure 274 with vertical adjustment as required. Provide concrete piers or Unistrut, Power strut, Multi A Strut or B-Line rack and fasten stands to piers or racks.
 - 5. Wall Supports: Provide one of the following means of supporting horizontal piping from wall:

- a. Furnish steel J-hook for pipe located close to wall, up to 3 inch pipe, Elcen Figure 46.
 - b. For hanger suspension with 750 pound maximum loading, furnish light welded-steel bracket with hole for one rod, 3/4 inch diameter, Grinnell Figure 191.
 - c. For pipe-roll stand support, furnish light welded-steel bracket for 700 pound maximum loading, Grinnell Figure 191.
- D. Vertical Piping Supports:
 - 1. All Pipe except Copper:
 - a. Vertical pipe supports shall be steel extension pipe-clamps, Grinnell Figure 261. Refer to manufacturer's rated maximum loading for each size pipe. Bolt clamp securely to pipe, rest clamp-end extension on building structure.
 - 2. Copper Tubing Support:
 - a. For un-insulated vertical lines, provide copper finished steel riser clamp, Grinnell Figure CT 121 or plastic coated steel riser clamp, Grinnell CT 121 C.
 - b. For exposed to view copper piping provide copper finished steel riser clamp.
- E. Beam Clamps:
 - 1. Non-"C-Style" beam clamps shall be malleable iron, Grinnell Figure 229 for 3/8 inch hanger rods, forged-steel beam clamp, Grinnell Figure 228 for hanger rod up to 1-1/2 inches.
 - 2. "C-Style" beam clamps shall be adjustable hanger rod type, malleable iron with set screw, jam nut, retaining clip, FM and UL approved, Grinnell Figure 61, 92, or 93.
 - 3. Where beam configuration does not allow horizontal movement of C-clamp when set screw and jam nut are positioned, retaining clips may be omitted.
- F. Inserts:
 - 1. Furnish and set inserts in concrete forms. Provide reinforcing rods for pipe sizes over 3 inches or equivalent.
 - 2. Concrete inserts shall be as follows: Black malleable iron universal type for threaded connections with lateral adjustment, Grinnell Figure 282 for pipe sizes up to 8 inches.
- G. Saddles and Shields:
 - 1. Saddles:
 - a. All domestic hot water piping and other piping over 90°F.
 - (1) For all piping 2-1/2 inches and larger installed on clevis or ring supports, provide Carpenter and Patterson Figures 351 thru 356, Grinnell Figures 160 thru 166A, or Pipe Shields Model CS.
 - (2) For all piping installed on roller supports, use the same saddles as listed above except use Pipe Shields Model CSX.
 - b. Cold Piping (less than 90°F.), any piping;
 - (1) For all piping installed on clevis or ring supports, provide Pipe Shields Model CS-CW.
 - (2) For all piping installed on roller supports, provide Pipe Shields Model CSX-CW.
 - 2. Shields:
 - a. Provide shields to protect insulation in all areas where saddles are not specified to protect insulation at areas of contact with hangers and supports.
 - b. Provide Grinnell Figures 167 or 168.
- H. Anchors:
 - 1. Pipe anchors shall consist of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces and sway braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe.
 - 2. Anchors shall be rigidly attached to substantial structure and shall resist movement, deflection, and bending. Attach anchors to steel structure by welding

or bolting, and to concrete structure by cast-in-place insert ties or by an approved expansion anchoring technique.

3. Installation shall conform to anchor details as may be found on the Drawings, and to supplemental requirements specified elsewhere in these Contract Documents.
 4. Provide factory made anchor components unless field conditions require shop-fabricated specials.
- I. Pipe Alignment Guides and Expansion Joints and Loops:
1. Guide expansion joints and loops with a minimum of two guides on the side opposite the anchor. Provide alignment guides to confine movement of piping due to thermal expansion and contraction between anchors, along the centerline axis.
 2. Guide piping in vertical chases at a maximum guide spacing of 15 feet.
 3. Unless shown or otherwise dimensioned on the Drawings, provide alignment guides at between 20 to 30 feet on centers and at equal distances from expansion loops occurring in horizontal piping.
 4. Provide pipe guides in accordance with the Contract Documents and the approved guide manufacturer's recommendations.
 5. Provide manufactured spider type carbon steel guides suitable to accept insulation. Provide galvanized steel guides for galvanized steel piping and black steel guides for all other steel piping. Paint guides for piping located outdoors.
 6. For copper tubing, provide specially-treated copper-clad riser clamps with spiders of the same manufacturer providing other alignment anchors for the project.
 7. Provide Grinnell Figure No. 255 and 256, Metraflex Style IV, or ADSCO Model No. E and E1 for piping 3 inches to 24 inches in diameter. For piping in sizes 1 inch through 2 inches, provide Grinnell figure No. 254, Metraflex Style IV or V (galvanized piping only), or ADSCO Model No. E and E1.
 8. Provide factory insulated pipe guides for piping systems specified to be insulated. Insulation in the insulated pipe guides shall be hydrous calcium silicate, maximum temperature of 1200°F., K factor of 0.31 at 75°F., compressibility of 100 psi. Vapor barrier shall be part of the insulation at the guide.
 9. Expansion joints shall be by Keflex, Metraflex or American Boa. Design is based on Keflex Series 311 joints.
 - a. Expansion joints shall be the bellows type construction with multi-ply, laminated, corrugated, Type 300 stainless steel bellows.
 - b. Joints shall be externally pressurized by the system fluid.
 - c. Pressure and temperature rating of the joint shall be at least equal to the rating of the adjoining piping system.
 - d. Provide end connections and the pipe companion connection as indicated on the drawings.
 - e. Joints shall satisfy the performance requirements as indicated on the drawings.
 - f. Provide expansion joints with drain plug and purge port 180 degrees apart from the drain plug.
 - g. Provide pipe swing joints at the take offs from piping mains to allow for piping expansion in multiple directions.
 - h. Joints shall be compatible with system fluids.
 - i. At piping penetrations at walls or floors, oversize penetrations to accommodate pipe expansion specified on the drawings. Fill the void between the pipe insulation and the penetration wall with mineral wool or fiberglass insulation. This insulation shall not compromise any fire barrier penetration requirements.
- J. Trapeze Hangers:
1. Trapeze hangers with hold-down clamps or U-bolts may be provided for hanging two or more parallel pipes which have a uniform slope throughout their adjoining runs. Each trapeze shall be securely attached to and supported by two steel

- rods to structure. Each trapeze shall be designed to support the span weight of all piping, insulation, and fluid carried by itself.
2. Provide standard continuous-slot metal channel framing members and appurtenances for pipe support where shown. Provide a system manufactured by Grinnell-Power-Strut, B-Line, Unistrut, Mult-A-Frame, or Power-Strut pipe support systems. Hot-dip galvanize all such members and appurtenances. Fittings, clamps, screws, nuts, bolts and washers shall be either hot dip galvanized or cadmium coated. Provide plastic insulating sleeves inside copper tubing clamps.
 3. If the Contractor elects to provide trapeze hangers for any portion of the Work, he shall provide engineering design and submit calculations, sealed by a practicing licensed professional engineer, showing accurate weight balance and supporting force at each hanger, suitability of hanger rods and other components, ability of connecting structure to satisfactorily carry all associated point loads, and connection/anchoring requirements to be used and their suitability.
 4. Minimum hanger rod sizes and maximum hanger/trapeze spacing for heat pump loop systems shall be in accordance with ANSI 31.1, ANSI B31.9 and MSS Standard Practice SP-58. Minimum hanger spacing for plastic heat pump loop material shall be in accordance with the pipe manufacturer's requirements to prevent sagging of the pipe.
- K. Expansion Loops/Expansion Joints
1. Where expansion loops are indicated, make up of 1 ½ radius ells, welding type, same weight as pipe installed, cold sprung to ½ calculated expansion. Guides and anchors shall be as indicated on the drawings and as specified in Section 15140.
 2. Expansion loops are preferred over expansion joints where space permits.
 3. Do not use expansion joints in the heat pump loop piping.
- L. Spring Hangers
1. Provide spring hangers where indicated to absorb pipe movement and stress.
 2. Size, spring constraint and compression or expansion status shall be as specified on the drawings.
 3. Refer to Section 15240 for addition requirements for spring hangers for piping systems.

PART 3. EXECUTION

3.1. INSTALLATION

- A. Provide hangers to support the required loads. Where necessary, supports shall be designed to permit movement due to expansion and contraction. Provide spring hangers to absorb stress. Where Drawings show details of supports and anchors, conform to details shown. Where details are not shown, conform to requirements of this Section.
- B. Support piping with hangers in direct contact with the pipe for insulated piping not requiring a vapor barrier except on pipes where pipe saddles are specified. Size hangers to fit on the outside of insulation requiring a vapor barrier and on pipes having pipe saddles.
- C. Hang pipe from substantial building structure. Piping shall not be hung from other piping or ductwork. All rigid hangers shall provide a means of vertical adjustment after erection. Do not suspend pipe from metal roof deck.
- D. "C" clamps shall be installed per manufacturer's recommendations.
- E. Where non-insulated pipes, in which vibration may occur, pass through walls, floors, or partitions, encase pipe within acoustical wall sleeves.
- F. Support piping assemblies in inaccessible chases adequately enough to be rigid and self-supporting before chase is closed. Provide adequate structural support for piping penetrating chase walls to fixtures.
- G. When piping is supported from walls, use welded steel brackets and wrought steel clamps. For hot pipes, furnish adjustable steel yoke and cast iron rollers.

3.2. HORIZONTAL PIPING SUPPORT SCHEDULE

- A. Support horizontal piping on threaded hot rolled steel rod. Threaded rod shall not be reduced to sizes smaller than provided for in support thread sizes.

B. Steel Pipe:

Maximum Spacing Between Single Pipe Supports:

Nominal Pipe Size, Inches										
1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	5	6
Maximum Span, Feet										
5	6	7	7	9	10	11	12	14	16	17
Minimum Rod, Inches										
1/4	1/4	3/8	3/8	3/8	3/8	1/2	1/2	5/8	5/8	5/8

C. Copper Tubing:

Maximum Spacing Between Single Pipe Supports:

Nominal Tubing Size, Inches										
1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	6	
Maximum Span, Feet										
5	5	6	7	8	8	9	10	12	14	

1. Furnish minimum rod size as specified for steel pipe of same pipe size.

D. Plastic Piping :

- 1. Applies to all thermo-plastic piping with either operating or anticipated ambient exposure temperatures up to 100°F. (maximum).
- 2. For pipe hanging other than included below, the pipe manufacturer's recommendations shall be adhered to.
- 3. Maximum spacing between single supports for horizontal piping.
 - a. PEX; spacing and components according to manufacturer's requirements.

- E. The spacing specified herein is included to limit deflection in the pipe to an acceptable minimum. Shorten intervals as necessary so the support manufacturer's maximum recommended safe load values in accordance with ANSI B31 are not exceeded.
- F. Trapeze Hanger: Spacing shall not be farther than the closest interval required for any size pipe supported thereby, or as necessary to prevent damage or failure to the structure. Provide additional framing as required to transfer loads to adequate structure.
- G. Supporting rods shall be attached to concrete by inserts placed before concrete is poured or to plates installed in the concrete as described above.
- H. Supporting rods over 18 inches long shall be braced at every fourth hanger with diagonal bracing attached to the structure for sway bracing.

3.3. VERTICAL PIPING SUPPORT

- A. Support vertical piping with wrought steel riser clamps. Make adequate provision for expansion, contraction, and lateral stability.
- B. Support steel pipe at a minimum of every other floor as required to relieve joint stresses.
- C. Where pipe sleeves extend above floor, place pipe clamps at ceiling below, support clamp-end extension from inserts.

3.4. SADDLES AND SHIELDS

- A. After installation, saddles shall be filled with the specified pipe insulation.

END OF SECTION 15140

**SECTION 15150
METERS**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Furnishing and installing of material required for the measurements of liquid, gas mass flow rates and for measurement of energy consumption, and pressure regulators of gas flow.
- B. Providing the domestic water and installation of a permanent meter.

1.2. SUBMITTALS

- A. Submit shop drawings on all equipment furnished under this section.
- B. Submit operation and maintenance manuals on the meters and regulators furnished under this section.

PART 2. PRODUCTS

2.1. MATERIALS

- A. Domestic water entrance to building:
 - 1. Prepare piping for new Stuart Public Works water entry piping. Provide additional building shut off valves for domestic water line if required for the extension of the domestic water.
- B. Domestic water meter:
 - 1. Prepare piping for new Department of Public Works furnished water meter at location shown. Meters shall be of manufacturer, size and type as approved by the Department of Public Works. Meter shall be valved on each side and have 3/4 inch valved drain. Piping associated with the meters shall be in accordance with Department of Public Works and as shown on the drawings. Install the water meters provided by the Department of Public Works, or specified to be provided by the Department of Public Works.
- C. Flow Indication and Control Systems (Heat Pump Loop, Domestic Water):
 - 1. The water flow indication and control system shall be one of the following types. Furnish flow elements (and meters) of the same manufacturer throughout the Project. Element locations shall be as shown on the Drawings.
 - 2. Fixed Venturi System:
 - a. Provide a complete flowset system manufactured by Olympic Valve, Inc, Bell & Gossett or Taco. Each flow element shall be provided with two pressure/temperature test ports with safety caps.
 - b. Piping Elements:
 - (1) Size 2 inch and smaller: The flow measuring supply valve shall consist of a 300 psig ball valve, flow measuring venturi, test ports and a ground joint union. Return valve shall consist of a butterfly valve, test port, and a ground joint union.
 - (2) Sizes 2-1/2 inch through 8 inch: Flow elements shall be cast iron venturis, same size as the pipe, rated at 250 psig at 250°F. The ends shall be full in accordance with ANSI B16.1 or of the wafer style precisely machined to fit between a pair of 150 lb. ASA flanges.
 - (3) Sizes 10 inch through 24 inch: Flow elements shall be carbon steel venturis, same diameter as the pipe line and meeting standard pipe specifications in accordance with ASTM A120. The end configuration shall be full flanged with dimensions meeting ANSI B16.5 - 150 lb.
 - (4) In sizes 4 inch and larger, Olympic pitot tubes may be used in lieu of venturis. Pitot tubes shall be the same diameter as the pipe, constructed of brass and stainless steel, and shall have brass pressure/temperature test ports. Tubes shall have a minimum working pressure of 250 psig at 250°F.
 - 3. Fixed Orifice Systems:

- a. The systems shall be of fixed orifice type, complete with piping elements and differential pressure kit(s). Each element shall contain two pressure test ports for connection to the test kit. Systems shall be designed for a minimum working pressure of 175 psig at 250°F.
- b. Piping Elements:
 - (1) Size 2 inches and Smaller:
 - (a) Element shall be a combination flow element and balancing valve.
 - (b) Manufacturers and Model No.
 - (i) Bell and Gossett Circuit Setter
 - (ii) Illinois Series 6000
 - (iii) TACO Circuit Setter (up to 3 inches size)
 - (iv) Flow Design
 - (v) Griswold
 - (vi) Robertson
 - (vii) Preso
 - (viii) Barco
 - (ix) Hays
 - (2) Size 2-1/2 inches and Larger:
 - (a) Element shall be a cast iron wafer-type body with stainless steel orifice designed for use between ANSI 125 lbs. flanges.
 - (b) Manufacturers and Model No.
 - (i) Bell and Gossett Circuit Sensor
 - (ii) Illinois Series 6000
 - (iii) Flow Design
 - (iv) Hays
 - (v) Griswold
- 4. Provide automatic flow adjusting valves manufactured by Auto Flow FDI, Griswold, or Hays at each separate heat pump coil or any other circuit that must have water metered. Provide the capability of providing automatic flow adjusting or balancing the flow to provide constant flow through the individual circuits regardless of which of any two parallel pumps is operational.

PART 3. EXECUTION

3.1. INSTALLATION

- A. Install all regulators in accordance with manufacturer's instructions and requirements and as shown on the Drawings. Install piping flow elements of proper distances from fittings and by method recommended by the manufacturer.

END OF SECTION 15150

**SECTION 15240
VIBRATION ISOLATION / MECHANICAL EQUIPMENT/ NOISE CONTROL**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Vibration isolators for mechanical equipment to prevent the transmission of vibration and mechanically transmitted sound to the building structure. It includes adjusting each mounting system, and measurement of isolator system performance when so requested by the Design Professional. Specific mounting arrangements for each item of mechanical equipment shall be as described and as indicated by schedules and details on the Drawings.
- B. Roof curbs for roof mounted equipment that provide specified sound attenuation.
- C. Flexible connection provided in ductwork to prevent vibration transmission from air moving device through the duct system.
- D. Duct mounted air silencers to provide noise reduction and sound levels in spaces specified.
- E. Miscellaneous vibration and noise control components.

1.2. QUALITY ASSURANCE

- A. Obtain from the drawings and confirm from shop drawings the approved manufacturers name, model number, and other necessary identifying data for each item of mechanical equipment to be resiliently mounted. Coordinate all resilient mounting systems with the exact equipment to be furnished in regard to physical size, isolator locations, weight, rotating speed, etc. Direct contact and cooperation between the vibration isolation device fabrication and the equipment manufacturer is required.
- B. Obtain all necessary data in regard to piping and duct systems which are to be resiliently supported so that proper isolators can be selected. Select system isolators for proper coordination with the physical arrangement of pipe lines or ductwork and with the physical characteristics of the building.
- C. Provide a system approach to vibration and noise control. Contractor shall provide the Vibro-Acoustic devices specified or Design Professional accepted equivalent by IAC, Mason, Peabody Noise Control, Korfund Dynamics Corp, Unisorb, Vibration Eliminator, Vibration Mounting and Controls.

1.3. SUBMITTALS

- A. Shop drawings and product data:
 - 1. Shop drawings shall include specific information as follows:
 - a. Manufacturer's model number for each isolator, the machine or pipeline to which it is to be applied, and the number of isolators to be furnished for each machine or pipeline.
 - b. For steel spring mounts or hangers: free height, deflected height, solid height, isolator loading, and diameter of spring coil.
 - c. For neoprene isolators: free height, deflected height, and isolator loading.
 - d. Dimensional and weight data for concrete inertia bases, steel and rail bases, and details of isolator attachment.
 - e. Details on roof curbs.
 - f. Sound attenuator sizes and noise reduction performance.
 - g. Vibration isolation capabilities for flexible connections for duct and piping.

1.4. JOB CONDITIONS

- A. Existing conditions: (prior to installation of vibration isolation equipment in the new project)
 - 1. Notify the Design Professional of any project conditions which affect vibration isolation system installation or performance and which are found to be different from conditions indicated by the Drawings or described by the specifications. Should vibration isolation system installation proceed without such notifications, any remedial Work required to achieve proper isolator performance shall be accomplished by the subcontractor at no additional cost to the Owner.

2. Be alert for possible "short-circuiting" of vibration isolation systems by piping supports, temperature control connections, drain lines, building construction, etc., and notify the involved contractor as to these problems or potential problems. Where such situations cannot be easily resolved, notify the Design Professional so that preventive or remedial action can take place on a timely basis. Any remedial measures required shall be undertaken by the subcontractor responsible at no additional cost to the Owner.

1.5. PERFORMANCE CRITERIA

- A. The overall mechanical system noise and vibration levels shall be controlled so the levels for the specified areas do not exceed the Noise Criteria and Room Criteria specified.
- B. The vibration and noise control components shall ensure that the NC/RC levels fall below the specified maximum levels indicated below.
 1. Corridors, NC/RC -35
 2. General Open Spaces, entry way NC/RC 25 to 30 (noise from air conditioning equipment only)
 3. Meeting rooms and Museum room; NC/RC 15: Less than
 4. Restroom and Kitchen; NC/RC 25 to 30
 5. Refer to drawings for noise level requirements in other spaces not listed.
- C. Refer to Section 15990 for noise level measurement requirements.

PART 2. PRODUCTS

2.1. MATERIALS

- A. Vibration isolators shall be selected by the isolator manufacturer in accordance with the weight distribution so as to produce reasonably uniform deflection. Furnish deflections shown. Not all isolator types specified are used. Refer to the drawing schedule for specific requirements.
- B. Where shown, scheduled, or specified, provide specific vibration isolation equipment. Where specific type of vibration isolation equipment is not shown or specified, furnish isolators recommended by one of the isolation manufacturers listed above, compatible with equipment arrangements shown. A single manufacturer for all vibration isolation equipment is required except as specifically approved in writing by the Design Professional.
- C. Bases:
 1. Base Type A - steel base: bases shall be one of the following types as determined by the isolator manufacturer.
 - a. Integral structural steel base: bases shall be rectangular in shape for all equipment other than refrigeration machines and pump bases which may be T-shaped. Pump bases for split case pumps shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the base. Beam depth need not exceed 14 inch provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1 inch. Bases shall be Mason Type "WF."
 - b. Steel rail base: bases shall be for equipment having legs or bases that do not require a complete supplementary base. Members shall be sufficiently rigid to prevent stress in the equipment.
 - 1) Bases with spring isolators: bases shall be constructed of steel wide flange members welded to height saving brackets. Base shall be Mason Type "ICS."
 - 2) Bases with neoprene isolators: base shall be steel channel rails, Mason Type "DNR."
- D. Isolators:
 1. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection.

2. Isolator Type 1 - neoprene mountings: double deflection neoprene mounting shall have a minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Bolt holes shall be provided for those areas where bolting is required. Use Mason Type "ND."
 3. Isolator Type 2 - freestanding springs: spring isolators shall be freestanding and laterally stable without any housing and complete with 1/4 inch neoprene acoustical friction pads between the base-plate and the support. All mounting shall have leveling bolts that must be rigidly bolted to the equipment. Springs shall be Mason Type "SLF."
 4. Isolator Type 3 - housed spring mounting with limit stop: springs in housings shall be as specified for Type 2. Housing shall include vertical resilient limit stops to prevent spring extension when weight is removed as when equipment is drained. The housing shall serve as blocking during erection and the installed and operating heights shall be the same. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Mountings used outside shall be hot dipped galvanized. Use Mason Type "SLR."
 5. Isolator Type 4 - vibration hanger: vibration hangers shall contain a steel spring and 0.3 inch deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Hangers shall be Mason Type "30N."
 6. Isolator Type 5 - vibration hangers: vibration hangers shall be specified for Type 4, but they shall be pre-compressed to the rated deflection so as to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Hangers shall be Mason Type "PC30N."
 7. Isolator Type 6 - vibration hanger: vibration hangers shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower holes sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Hangers shall be provided with an eye bolt on the spring end and provision to attach the housing to the flat iron duct straps. Hangers shall be Mason Type "W30."
 8. Isolator Type 7 - vibration hanger: hanger shall be a double deflection neoprene-in-shear Type 2 having a minimum static deflection of 0.35 inch. Hanger shall be Mason Type "HD" or "WHD."
 9. Isolation Pads, Type 8 – Equipment Support Rail Or Foot Isolators.
 - a. Pads shall be Mason Industries, "Mini Super W" pads with a 180 pounds load capacity at 15% deflection for each 2 inches x 2 inches square. Stack pads with 16 gage shims between pads for increased deflection requirements. Pads shall be standard neoprene. For concentrated load such as the small leg support of a machine, provide the Mason Industries "WMSW" or "MBSW" pads.
- E. Isolation of piping systems:
1. All piping which connects to resiliently mounted and vibrating equipment shall be suspended with resilient hangers or supported by floor mounted isolators. The first three supports from the connected machine shall have the same static deflection as indicated for the machine. The next two supports shall have static deflection at least equal to one-half of the static deflection indicated for the

machine mounting, and the remaining pipe supports shall provide static deflection of 0.35 inch minimum.

2. Where static deflection in excess of 0.35 inch is required, floor isolators shall be Type 3 and isolation hangers shall be Type 5. Where deflection of 0.35 inch or less is required, floor isolators shall be Type 1 and isolation hangers shall be Type 7.
3. Piping Flexible connections:
 - a. Flexible neoprene connectors shall be used to connect all piping to all isolated equipment except equipment for which flexible connectors are not permitted by code or at connections to heat pump units. For applications where code prohibits using flexible connectors, provide swing connections changing direction a minimum of 3 times before joining isolated equipment. Swing connections should be made within approximately 6 feet of the isolated equipment.
 - b. Connectors to equipment other than heat pump units shall be manufactured of multiple plies of nylon tire cord fabric and neoprene both molded and cured in hydraulic presses. No steel wire or rings shall be used as pressure reinforcement. Connectors up to and including 2 inches diameter may have threaded ends. Connectors 2-1/2 inches and larger shall be manufactured with floating steel flanges. All connections shall be rated a minimum of 150 psi at 220°F. All flanged equipment shall be directly connected to neoprene elbows in the size range 2-1/2 inches through 6 inches or any larger available size if the piping makes a 90 degree turn at the equipment; all straight through connections shall be made with either flanged or screwed connectors properly pre-extended as recommended by the manufacturer to prevent additional elongation under pressure. Sizes 12 inches and larger operating at pressures above 100 psi shall employ control cables with end fittings isolated from the anchoring plates by means of 1/2 inches thick bridge bearing neoprene washer bushings designed for a maximum of 1000 psi.
 - c. Elbows shall be Mason-flex Type "Mfnec," straight connectors Mason-flex Type "Mftfu" or "Mftnc," and control cable assemblies Type "ACC"; all manufactured by Mason Industries, Inc.
4. Drain connections from isolated equipment to floor drains shall be at least 1 inch free from drain.
5. Acoustical sleeves: where piping passes through equipment room walls, floors or ceilings, the vibration isolator manufacturer shall provide a split seal consisting of two bolted pipe halves with 3/4 inch or thicker neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete shall be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1 inch past either face of the wall. Where temperatures exceed 240°F. 10 lb. density fiberglass shall be used in lieu of the sponge. Seals shall be Mason Type "SWS."
6. Piping not specified to be supported by resilient hangers but located in mechanical equipment room shall have either fiberglass insulation or a felt strip between the hanger and the pipe wall.
7. Piping smaller than 2 inches in diameter shall have resilient hangers if specified on the drawings.
8. Vertical pipe risers shall be isolated from the structure by means of vibration and noise isolating expansion hangers. Hangers shall have a minimum rated deflection of four times the anticipated pipe expansion and shall be enclosed in a housing for fail-safe operation. Hangers shall be Type 4. Friction clamps are not permitted.
9. Install resilient hangers on any piping that is not resiliently supported but is causing excessive vibration when in operation. The Design Professional will

decide to what extent resilient hangers shall be used to replace the rigid supports.

- F. Isolation of fractional horsepower equipment: All fractional horsepower fans, pumps, etc., which are mounted on or suspended from floors that are not on-grade, shall be isolated with neoprene-in-shear isolators furnished by the vibration isolation supplier except where such isolators are furnished as an integral part of the machine.
- G. Electrical connections to resiliently mounted equipment: Electrical connections to equipment which is supported or suspended by vibration isolators shall be made with long lengths of flexible conduit or flexible armored cable. These flexible connections must be located so as to prevent rigid connections between the resiliently mounted equipment and the building structure.
- H. Replace isolators which do not produce the required deflection, are improperly loaded above or below their correct operating height, or which do not produce the required isolation.
- I. Notify the Design Professional of project conditions which affect vibration isolation system installation or performance and which are found to be different from conditions indicated.
- J. Be alert for possible "short-circuiting" of vibration isolation systems by piping supports, electrical connections, temperature control connections, drain lines, building construction and notify the involved contractor about these problems or potential problems. Where such situations cannot be easily resolved, notify the Design Professional so that preventive or remedial action can take place on a timely basis.
- K. "Non-vibrating equipment" such as water heaters shall be supported by Type 9 isolators.
- L. The isolator manufacturer's submittal shall include the complete design for the supplementary bases, a tabulation of the design data on the isolators, including outside diameter, free, operating, and solid heights of the springs, free and operating heights of the neoprene or fiberglass isolators, and isolation efficiency based on the lowest operating speed of the equipment supported.
- M. Flexible connections shall be incorporated in the ductwork connections to all air-moving units. The connections shall be neoprene impregnated canvas of approved construction meeting the requirements of NFPA 90A.
- N. All ductwork, for a minimum distance of 30 feet-0 inches from air moving devices such as fans up and downstream shall be isolated from the structure with combination spring and neoprene hangers in the supporting members. Hangers shall be Type 6, as described above and shall have a static deflection of 1/4 inch.
- O. Flexible Connections. 6 inches flexible connections shall be installed between all rigid ductwork or casing and all air handling/in-line fan equipment not integrally provided with vibration isolation within fan casing except for connections in curb mounted exhaust fans and terminal units. Connections shall be of asbestos-free fireproof material and suitable for temperatures and pressures involved. Connection materials shall not exceed a factory tested flame spread rating of 25 or a smoke developed rating of 50. At least 1 inch slack shall be allowed in these connections to insure that no vibration is transmitted from fan to ductwork. Fabric shall either be folded in with metal or attached with metal collar frames at each end to prevent air leakage. Furnish Ventfabrics "Ventglass."
- P. Sound Attenuators.
 - 1. Provide factory-fabricated sound attenuators, as shown, manufactured of minimum G90 galvanized sheet steel casing and liner by Industrial Acoustics Company, Semco, AeroSonics, Inc., Commercial Acoustics, Vibro Acoustics, Koppers, United McGill Corp., Dynasonic or Rink. Furnish sound attenuator factory constructed and rated by an independent testing company to meet requirements of ASTM E477. Units shall meet minimum scheduled performance criteria for octave band sound reduction characteristics (dynamic insertion loss, DB, airflow generated noise DB), and shall not exceed pressure drop, as shown on the Drawings.
 - 2. Submittals shall include certified test data on Dynamic Insertion Loss, Self-Noise Power Levels, and Aerodynamic performance for reverse and forward flow test

conditions on units of size and face velocities scheduled on the Drawings, and air pressure drop. Octave band sound data shall be submitted.

3. Sound attenuators shall be factory fabricated, tested by an approved laboratory and sound reduction warranted by manufacturer. Units shall be constructed to be air tight when operating under an internal pressure of 8 inches of water. Lock seams shall be filled with commercial mastic. Where used, welded seams shall be of the continuous type weld. No rivets will be allowed through the case of the unit under any circumstances.
 4. Noise reduction values shall be met in all frequency bands.
 5. Sound attenuators to have enclosure not less than 22 gage galvanized steel with 3/4 inch galvanized stiffeners and 26 gage galvanized interior partitions for rectangular units.
 6. Tubular attenuators shall be made of galvanized steel in the following gages:

Outside Diameter	Metal Gage
12 inches through 22 inches	24
24 inches through 40 inches	20
44 inches through 48 inches	16
48 inches	14
 7. Internal partitions for tubular silencers shall be compatible with the outside casings.
 8. Acoustical filler material shall be inorganic mineral of glass fiber of a density sufficient to obtain the specified acoustic performance and be packed under not less than 5% compression to eliminate voids due to vibration and settling. Material shall be inert, vermin and moisture proof. Media shall be capable of being cleaned.
 9. Combustion rating for attenuator acoustic fill shall be not more than 25 flame spread, 50 smoke development and 50 fuel contribution.
- Q. Sound Attenuation/Sound Output Control for Specified Equipment
1. Equipment as specified on the drawings shall be provided with sound attenuating wrapping. Minimally, this shall include duct mounted vane axial fans.
 2. The acoustical wrapping shall be the Trane Company Acoustic Blanket System by Insultech, VibraCoustics, IAC, Mason, or Peabody. The wrap shall be suitable for outdoor use and shall be impervious to moisture. The wrap shall be non-flammable, chemical resistant and abrasion resistant.
 3. Specific components of the sound attenuating wrap shall be as follows:
 - a. The outer and outer jackets shall be 16.5 oz/SY PTFE teflon impregnated fiberglass cloth.
 - b. The acoustical barrier shall be barium sulfate loaded vinyl at 1 pound density.
 - c. The fiberglass media shall be fiberglass needled mat at 11 pounds per cubic foot density.
 - d. Blanket construction shall be double sewn lock stitch with seven (7) stitches per inch minimum. All raw jacket edges shall have tri-fold teflon cloth binding stitched with teflon coated fiberglass thread. No raw cut jacket edges shall be exposed.
 - e. Provide extended 2 inches wide fabric vinyl flaps to cover exposed seams.
 - f. Provide stainless steel quilting pins at random locations no greater than 18 inches apart to prevent shifting of the insulation.
 - g. Provide velcro flaps stitched into the blankets for fastening purposes. The velcro flaps shall be 2 inches wide.
 4. Provide the sound attenuating package that provides for a 6 - 8 dBA noise reduction.
 5. Submit shop drawings showing the attenuation package components, installation instructions and sound attenuating performance.
- R. Provide "perforated plate" low frequency noise blocks as indicated on the drawings.
- S. Provide duct run-by on each supply diffuser to provide sound trap.

PART 3. EXECUTION

3.1. INSTALLATION

A. Vibration isolation hangers:

1. Resilient hangers shall be installed as near as possible to the supporting overhead structure. The machine suspension points shall be in a rigid and heavy portion of the building structure. Suspension of machines from lightweight floor slabs shall be avoided, particularly at the center of structural spans. Do not suspend from metal roof deck.
2. Suspension rods shall be attached to rigid member of the machine structure. When such attachment points do not exist, a heavy steel framework shall be furnished to support the machine with suspension rods attached to this framework.

B. Silencers/attenuators

1. Install attenuators in ductwork where recommended by the analysis of the vibration and noise control components manufacturer.

3.2. FIELD QUALITY CONTROL

- A. Provide on-the-job supervision as required during installation of resiliently mounted equipment and piping to assure that all vibration isolators are installed in strict accordance with manufacturer's instructions.
- B. Replace, at no extra cost to the Owner, any isolators which do not produce the required deflection, are improperly loaded above or below their correct operating height, or which in any way do not produce the required isolation.

END OF SECTION 15240

**SECTION 15250
MECHANICAL INSULATION**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Mechanical equipment and system insulation and sound attenuating material.
- B. The design objectives of the piping, equipment and ductwork insulation systems are as follows.
 - 1. Condensation control for "cold" piping.
 - 2. Energy conservation.
 - 3. Fire Safety.
 - 4. Freeze protection.
 - 5. Noise control.

1.2. QUALITY ASSURANCE

- A. All insulation shall have composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation) fire and smoke hazard ratings as tested by procedure ASTM E84, NFPA 255, NFPA 90A and UL 723 not exceeding (unless otherwise specified):
 - 1. Flame Spread: 25
 - 2. Smoke Developed: 50
 - 3. Accessories such as adhesives, mastics, cements, tapes and flame resistant cloth for fittings shall have the same component rating as listed above.
- B. Type and insulation thickness shall comply with the minimum requirements of the International Energy Conservation Code, 2009. Insulation type and thickness specified in some cases may exceed minimum Energy Code requirements.
- C. The "Whole Building" Design Guide" (WBDG) Mechanical Insulation Design Guide (MIDG) shall be basis for insulation material details and installation. Refer to www.wbdg.org/design/midg.

1.3. PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Material shall be furnished to the job bearing manufacturer's label.

1.4. SUBMITTALS

- A. Submit shop drawings for duct insulation, pipe insulation, sound attenuating material and insulation covering.

PART 2. PRODUCTS

2.1. MATERIALS

- A. Tape: Wherever tape is used for sealing purposes, it shall be of type and applied as recommended by the nonconductive covering manufacturer. Where recommendation is lacking, tape used shall be sealed with Minnesota Mining adhesive EC-1329.
- B. Insulating Cement: Insulating cement shall be Owens-Corning 110 mineral wool, all purpose cement. Where insulating cement is applied to pipe fittings in concealed locations, it shall be "one coat" cement.
- C. Fiberglass Pipe Insulation:
 - 1. Insulation shall be a one-piece type made from long glass fibers bonded with a thermosetting resin molded into a hollow cylinder and jacketed with a kraft-reinforced foil all-service vapor barrier jacket (ASJ). The jacketing shall have a factory applied double pressure-sensitive adhesive system which provides positive closure and vapor sealing of the longitudinal joint.
 - 2. Physical Properties:
 - a. Operating temperature range: -20°F. to +850°F.
 - b. Thermal Conductivity: -0.25 BTU-IN/hr-sq.ft. - deg. F at 75°F.
 - c. Water Vapor Permeance: 0.02 perm max.
 - 3. Manufacturer's insulation shall be Certainteed Snap On, Knauf Pipe Insulation, Manville Micro-Lok, or Owens-Corning Fiberglass ASJ/SSL-II.
- D. Fiberglass Duct Wrap Insulation:

1. Insulation shall consist of an inorganic blanket of glass fiber, factory-laminated to a reinforced foil kraft (FRK) vapor barrier facing. A 2 inch stapling and taping flange shall be provided on one edge.
 2. Physical Properties:
 - a. Operating Temperature Range: 40°F. to 250°F.
 - b. Density: 0.75 lb/cu. ft.
 - c. Thermal Conductivity: 0.31 BTU-IN/hr-eq. ft. - deg. F
 - d. Water Vapor Permeance: 0.02 perms max.
 - e. Ductwork insulation shall be a minimum of R-5 for interior insulation and R-8 for exterior insulation in accordance with IECC 2009.
 3. Manufacturer's insulation shall be Certainteed, Knauf, Manville, or Owens-Corning.
- E. Acoustical Duct Liner:
1. General: Acoustical duct liner shall be a bonded mat of glass fiber coated with a black pigmented fire-resistant coating on the airstream side. Liner shall be suitable for operating temperatures up to 250°F. Liner shall be manufactured by Certainteed, Knauf, Manville, or Owens Corning.
 2. Flexible Liner: Liner shall have a minimum density of 1-1/2 pounds per cubic foot and shall be suitable for air velocities up to 5000 feet per minute. Thermal conductivity shall not exceed 0.28 BUT/HR square foot degrees F/IN at 75°F. Sound absorption coefficient shall not be less than 0.65 in the 500 cycles/sec. octave band center frequency for 1 inch thick material based on No. 6 mounting in accordance with ASTM C423-77 test procedure. Air friction correction factor shall not exceed 1.20 at 1500 fpm and 1.25 at 5000 fpm based on TIMA Test Method AHS-152.
 3. Rigid Duct Liner Board: Liner shall have a minimum density of 3 pounds per cubic foot and shall be suitable for air velocities up to 4000 fpm. Thermal conductivity shall not exceed 0.23 BTU/HR square foot degrees F/IN at 75°F. Sound absorption coefficient shall be not less than 0.64 in the 500 cycle/sec. octane band center frequency for 1 inch thick material based on No. 6 mounting in accordance with ASTM C423 test procedure. Air friction correction factor shall not exceed 1.25 at 1500 fpm and 1.3 at 3000 fpm.
 4. Duct liner shall be impregnated with anti-mold and anti bacterial media that meets current ASHRAE standards for use in HVAC systems.
 5. Duct liner/insulation shall be a minimum of R-5 for interior locations and R-8 for exterior locations in accordance with IECC 2009.
- F. Acoustical Duct and Pipe Wrap:
1. General: Acoustical duct and pipe wrap shall be a bonded mat of glass fiber coated with a black pigmented fire-resistant coating on the airstream side. Wrap shall be suitable for operating temperatures up to 250°F. Wrap shall be manufactured by Certainteed, Knauf, Manville, or Owens Corning.
 2. Flexible wrap: wrap shall have a minimum density of 1-1/2 pounds per cubic foot. Thermal conductivity shall not exceed 0.28 BTU/HR square foot degrees F/IN at 75°F. Sound absorption coefficient shall not be less than 0.65 in the 500 cycles/sec. octave band center frequency for 1 inch thick material based on No. 6 mounting in accordance with ASTM C423 test procedure.
- G. Fiber glass semi-rigid board insulation:
1. Board form:
 - a. Insulation shall be made from inorganic glass fibers preformed into boards bonded by a thermosetting resin, and furnished with an All-Service Jacket (ASJ) composed of a reinforced white kraft and aluminum foil laminate with the white kraft facing out.
 - b. Physical Properties:
 - 1) Temperature Limit: to 450°F.
 - 2) Density: 3 lbs/cu. ft.

- 3) Thermal Conductivity: 0.25 BTU-IN/hr-sq. ft. - deg. F at 75°F.
 - 4) Water Vapor Permeability: 0.20 perm-in.
 - c. Manufacturers: Insulation shall be Certainteed 1B Board, Knauf Insulation Board, Manville 800 Series Spin-Glass, or Owens-Corning 700 Series.
- 2. Flexible forms:
 - a. Insulation shall be composed of high temperature fiber glass bonded to a flexible jacket with the end grain of the insulation perpendicular to the jacket surface. This construction shall provide a product of high compressive strength while permitting the insulation to conform to rounded surfaces without reducing the thickness. Jacket shall be a laminated kraft aluminum foil all service jacket (ASJ) with vapor barrier.
 - b. Physical Properties:
 - 1) Temperature Limit: to 650°F.
 - 2) Density: 3 lbs/cu. ft.
 - 3) Thermal Conductivity: 0.27 BTU-IN/hr-sq. ft. - deg. F at 75°F.
 - 4) Water Vapor Permeability: 0.02 perms.
 - 3. Manufacturer's insulation shall be Knauf Flex-Wrap, Manville Pipe and Tank Insulation, or Owens-Corning Pipe Wrap Insulation.
- H. Provide elastomeric insulation on insulated piping that is exposed to high moisture conditions, such as exist in the janitor's closet areas.
- I. Flexible Elastomeric Insulation:
 - 1. Insulation shall be of closed-cell structure with a smooth surface. Pipe insulation shall be factory molded to fit the pipe snugly.
 - 2. Type 1 Insulation:
 - a. Density: 6 lbs/cu. ft.
 - b. Operating Temperature Ranges: -297°F. to +220°F.
 - c. Thermal Conductivity: 0.28 BTU-IN/hr-sq. ft. - deg. F at 75°F.
 - d. Water Vapor Permeability: 0.20 perm-in.
 - e. Flame Spread: 25.
 - f. Smoke Density: 50 for thickness 3/4 inch and smaller, 100 for 1 inch thickness.
 - g. Pipe insulation shall be Armstrong AP Armaflex, Halstead Insul-Tube, or Rubatex R-180-FS. Sheet insulation shall be Armstrong Armaflex II, Halstead Insul-Tube, or Rubatex R-1800-FS.
 - 3. Type 2 Insulation:
 - a. Insulation shall be preslit tubular form with a pressure-sensitive adhesive system for closure and vapor sealing of the longitudinal joint.
 - b. Density: 4 lbs/cu. ft.
 - c. Operating Temperature Ranges: 40°F. to 200°F
 - d. Thermal Conductivity: 0.28 BTU-IN/hr-sq. ft. - deg. F.
 - e. Water Vapor Permeability: 0.20 perm-in.
 - f. Flame Spread: 25.
 - g. Smoke Density: 50.
- J. Pipe Fitting Covers:
 - 1. Paint covers, fiberglass insulation fittings located in equipment rooms and behind ceilings and walls that are not to be painted, to provide water vapor seal.
 - 2. Pre-molded covers for fiberglass insulation fittings that are specified to be painted - fiberglass fittings with all-service vapor barrier jacket similar to adjacent pipe covering.

PART 3. EXECUTION

3.1. INSTALLATION

- A. The insulation and materials shall be applied only by mechanics skilled at such Work. The appearance of the finished Work shall be of equal importance with its mechanical correctness and efficiency. Insulation for heating surfaces and piping shall not be applied until such times as those surfaces are sufficiently heated to properly dry out the

insulation. Insulation shall not be applied to a specific system until the system has been pressure and leak tested as specified.

B. Installation:

1. Wherever vapor barriers and waterproof covering are specified, all portions of the covering at joints and fittings shall be vapor sealed.
2. Insulation shall be continuous through all walls, floors, and ceilings, unless otherwise specified, or shown.
3. Where insulation is to be painted, all surfaces shall be properly prepared to receive paint. Coordinate the insulation type and associated covering with the painting requirements. Refer to Section 15010 for additional coordination requirements.
4. Insulate unions, flanges, and valve bodies but not operating handwheels or levers.
5. Application of all materials shall be in accordance with the manufacturer's instructions.
6. The insulation shall be handled in a manner that will not adversely affect its structural or insulating properties.
7. Support shall be provided for the insulation on vertical lines to prevent the insulation from slipping downward.
8. Care shall be taken so as not to place insulation over vent and drain inlets and outlets.
9. Self-sealing laps shall have an additional field applied coat of adhesive applied to the opposite mating surface.
 - a. Both hot and cold pipe self-sealing jacket laps on longitudinal and butt joints shall be stapled at 6 inch maximum spacing (both exposed and concealed). On cold pipe insulation, the staples and the longitudinal and butt edges shall be sealed with mastic.
10. Fittings and Valves:
 - a. Hot pipelines (above 60°F.): Flanges, couplings, valves, anchors, and fittings shall be insulated with factory premolded, prefabricated or field fabricated sections of insulation of the same material and thickness as the adjoining pipe insulation. When segments of insulation are used, elbows shall be provided with not less than three segments. When nesting size sections of insulation are used, all voids shall be filled with insulating cement or mineral fiber. Sections of insulation shall be secured in place with wire or by joining the sections with adhesive. Adhesive shall be applied over the insulation in two coats with tape embedded between coats. Tape shall overlap itself 1 inch and adjoining insulation jacket 2 inch. (When required, insulated flanges, couplings, valves, anchors, and fittings shall be covered with preformed or field-fabricated sections of aluminum jacket secured with bands in lieu of finishes specified above. When pipe insulation with factory-applied aluminum jacket is provided, flanges, valves and fittings may be insulating with factory-or-field-fabricated sections of the same material and thickness as adjoining pipe insulation and jacket. Sections shall be secured with bands.) Unless otherwise shown, unions will not be insulated and pipe insulation and jacket shall terminate neatly at the ends of unions. All termination points shall be finished with brush coat of adhesive.
 - b. Cold pipelines (-30°F. to +60°F): Flanges, couplings, unions, valves, anchors and fittings unless otherwise shown shall be insulated with factory pre-molded, prefabricated or field fabricated sections of insulation of the same material and thickness as the adjoining pipe insulation. Anchors, when secured directly to the pipe shall be insulated for a distance to prevent condensation, but not less than 6 inch from the surface of the pipe insulation. Insulation and vapor barrier shall be extended to cover glands and stem completely. When segments of insulation are used, elbows shall be provided with not less than three segments. When nesting size sections of insulation

are used, all voids shall be filled with insulating cement or mineral fiber. Sections of insulation shall be secured in place with wire or by joining the sections with adhesive. Vapor barrier coating shall be applied over the insulation in two coats with glass tape embedded between coats. Tape shall overlap itself 1 inch and adjoining insulation jacket 2 inch. The coating shall be applied to a total dry film thickness of not less than 1/16 inch. (When required, insulated flanges, couplings, unions, valves, anchors, and fittings shall be covered with preformed or field-fabricated sections of aluminum jacket applied over the vapor barrier and secured with bands). Where unions are shown to be not insulated, the pipe insulation and jacket shall terminate neatly at the ends of the unions. Ends of pipe insulation shall be sealed to the pipe with a brush coat of vapor barrier coating at termination points, valves, flanges, and fittings.

11. Pipe Insulation:

- a. Heat pump loop piping: provide flexible elastomeric Type 1, type 2, or fiberglass insulation on the heat pump loop piping as follows:
 - 1) 1 inch thick on all interior piping except non-recirculating runouts to the heat pumps on pipes up to 2 inch in diameter.
 - 2) 1-1/2 inch thick on all interior piping above 2 inch in diameter.
 - 3) 1/2 inch thick on non-circulating runouts including flexible connections to the heat pumps. Runouts shall be defined as within 4 feet-0 inch of the unit.
 - 4) Any buried heat pump loop piping that is within 5 feet-0 inch on either side of, or runs parallel to any wall, structure, sanitary sewer or water pipe within 5 feet-0 inch shall be insulated with 1 inch thick insulation.
 - 5) Heat pump loop penetrations through the building wall shall be insulated through the building penetrations and up to 5 feet-0 inch from the building structure penetrations.
- b. Plumbing Systems: Insulation shall be fiberglass pipe insulation or flexible elastomeric, Type 1 or 2, thickness as scheduled below. Cooling coil condensate drain piping shall only have flexible elastomeric insulation. Type 1 plumbing piping insulation that is specified to be painted shall be fiberglass insulation.

SYSTEM	TEMP RANGE	PIPE SIZES, inches			
		Non-Circ. Runouts up to 1 in.	1 ¼ and less	1 ½ to 2	2 ½ and up
Cold Water Domestic, Water above and below floor	Any	0.5	0.5	0.5	0.5
Hot Water Domestic above and below floor including circulation piping	100-140	1.0	1.0	1	1.0
Heat pump coil and cooling coil condensate, condensate piping in equipment rooms does <u>not</u> need to be insulated.	Any	0.5	0.5	0.5	0.5

12. Valves and Fitting Jackets:

a. Valves and fitting jacket shall be as scheduled below:

SYSTEM	LOCATION	JACKET
Hot Water Domestic	All Concealed	Tape and Adhesive
Hot Water Domestic	All Exposed	Tape and Adhesive
Cold Water Domestic, Heat Pump Loop	All Concealed	Tape and Vapor Barrier
Cold Water Domestic, Heat Pump Loop	All Exposed	Tape and Adhesive

13. Duct Insulation:

a. Duct insulation shall be as scheduled below. All flexible ductwork shall be insulated similar to rigid ductwork.

SYSTEM	LOCATION	INSULATION	FORM
Supply Air (Includes supply from ventilation units) and from central de-humidifiers and heat recovery units	Concealed in Heating and Cooled space, including duct covered by soffit or above ceiling, immediately downstream from water to air heat pump unit, or cooling or heating unit.	Fiberglass Duct Wrap 1½ inch	Flexible
Transfer Duct	Exposed, Concealed	Fiberglass, Flexible Duct Wrap, 1 ½ inch or Fiberglass Acoustical Duct Liner, 1 inch for sound traps that are custom made. Refer to drawings for extent of sound traps	N/A Flexible, acoustical liner
Return Air	All Concealed in Heated and Cooled spaces.	Fiberglass Flexible Duct Wrap, 1 ½ inch	Flexible
Outside Ventilation downstream of Heat Recovery System Air, Outside air upstream of any unit	All	Fiberglass Acoustical Duct Liner, 1 inch unless noted otherwise on the drawings	Flexible
Exhaust Air from that is part of heat recovery system. (Insulate only 10'-0 inch upstream of exhaust fan for exhaust not part of heat recovery system.)	All	Fiberglass Flexible Duct Wrap, 1 ½ inch	Flexible

- 1) Above ceiling spaces used as supply air plenums shall be considered as cooled and heated spaces. Above ceiling spaces not used as supply air plenum shall require insulation of ducts as specified above.
- 2) Where acoustical duct liner is used, the duct sizes shown on the Drawings shall be net inside dimensions.
- 3) Refer to the drawings for additional requirements for acoustical lining for transfer, supply, return and exhaust ducts.

- 14. Equipment Insulation:
 - a. Equipment insulation shall be as scheduled below.
 - 1) Heated Equipment:

EQUIPMENT	INSULATION	FORM
Heat pump	Flexible fiberglass, 1 inch Type 1 or 2 Elastomeric	Flexible
Glycol mixture feeders, expansion tanks	Flexible fiberglass, 1 inch Type 1 or 2 Elastomeric	Flexible

- 2) Cold equipment:

EQUIPMENT	INSULATION	FORM
Air Conditioning Equipment Housings, Interior	Duct Wrap 1 1/2 inch	Rigid Board
Air/Dirt Separators	1 inch Semi-rigid Board, or Flexible Elastomeric	Board or Flexible
Heat Pump Loop Water Pumps, Water to Water Heat Pump, any portion of unit that will "sweat" (see manufacturer)	Semi-rigid Board Insulation, 1 inch or Flexible Elastomeric, 1 inch Type 1 or 2	Board or Flexible Sheet, Type 1 or Type 2
Flexible ductwork connection to heat pump, air conditioning unit	Flexible Elastomeric, Type 1 or 2, 1 inch	Flexible
Water Pumps, Heat Exchangers, Separate cooling coils any portion of unit that will "sweat"(see manufacturer),	Flexible Elastomeric, 2 inch Type 1 or 2	Flexible Sheet, Type 1 or 2

- 3) Equipment to be insulated shall include valves, strainers, dirt separators, check valves, expansion tanks and other piping components in all systems.

- 15. The insulation subcontractor/Division 15 contractor shall provide all insulation for ductwork and piping systems that are field installed, even if such components are installed inside a terminal unit or air handling unit in the field.

END OF SECTION 15250

**SECTION 15410
PLUMBING PIPING**

PART 1. GENERAL

1.1. DESCRIPTION OF WORK

- A. This Section includes general plumbing piping systems, such as gravity drain sewers, domestic water piping.

1.2. QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:

1. It is the intent of this Specification that all Work be acceptable under an applicable standard stated or cited in the Uniform Plumbing Code or accepted as suitable for proposed use under procedures and powers of authority having jurisdiction.
2. Finish Work shall conform as nearly as practicable to essential requirements of this Section. Connection to sewers shall be as required by local authorities. Where existing utilities are shown to be abandoned or removed, perform all Work required and remove or close off as required by local codes.
3. Materials shall comply with Uniform Plumbing Code requirements.

1.3. SUBMITTALS

- A. Certificates: furnish to Owner, County Health Department, City Health Department, Design Professional, and a certificate of compliance with the chlorination of system paragraph in this Section.

PART 2. PRODUCTS

2.1. MATERIALS

- A. Potable Water Piping:

1. Water service (including softened water and hot circulating) under the floor slab shall be:
 - a. Cement-lined ductile cast iron with ductile iron water service fittings having restrained (lock-ring) or push-on mechanical joint type.
2. Hot and Cold Potable Water Piping inside the building:
 - a. Exposed piping in finished rooms of the facility used in connection with plumbing fixtures shall be chromium-plated brass pipe with plated cast brass fittings.
 - b. PEX piping provided shall be in accordance with all requirements specified in the Uniform Plumbing Code.
 - c. For metal water piping
 - 1) All copper piping shall be copper tubing Type L or K; fittings for copper tubing shall be wrought copper or cast bronze (tinned when brazed).
 - 2) Press copper fittings for copper domestic water piping.

- B. Sanitary, and Vent Piping:

1. Sanitary, and vent piping above grade shall be service weight or heavier cast iron soil pipe and fittings, standard weight galvanized steel pipe with black cast iron drainage fittings.
2. Sanitary drainage and vent piping underground outside the building wall shall be service weight or heavier cast iron soil pipe and fittings. Underground joints in cast iron soil pipe to be made with packed oakum and lead or approved hub and spigot joints.
3. Copper drainage piping, Type L or Type M may be used in accordance with UPC requirements, limitations for sanitary drainage.
4. All above and below grade cast iron soil pipe and fittings shall conform to current CISPI 301, ASTM 888 or ASTM A74 requirements. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI).

5. Joints for cast iron soil pipe shall be as follows.
 - a. No hub couplings: No hub couplings shall conform to CISPI Standard 310 and ASTM standard A1277.
 - b. Heavy duty couplings shall conform to ASTM C1540 requirements.
 - c. Compression gaskets for hub and spigot joints shall conform to requirements of ASTM Standard C 564 and ASTM Standard C1563.
6. Inside sanitary and vent piping may be PVC piping in accordance with UPC-2006 requirements and limitations.
- C. Cold Equipment Defrost Drains and Cooling Coil Condensate Drainage Piping:
 1. Piping shall be same as specified for sanitary drainage piping.
- D. Hot Equipment Drainage Piping:
 1. Drains shall be copper, Type L or Type M with copper drainage fittings, or cast iron.

PART 3. EXECUTION

3.1. INSTALLATION

- A. Potable Piping:
 1. Underground and Under Slab Service Mains:
 - a. Concrete anchor blocks shall be installed on all otherwise non-restrained underground lines at tees and elbows to prevent fittings from being blown off lines when under pressure. Where pipe ends are left for future connections, they shall be valved, plugged, or capped as shown on Drawings. Where connections are made between new Work and existing mains, connections shall be made by using specials and fittings to suit actual conditions.
 - b. Ductile Iron Service: For piping 2 ½ inches in diameter and larger install ductile iron pipe in accordance with all applicable requirements of AWWA Standard C600.
 - c. For underground piping 2 inches in diameter or less provide Type "K" copper with brazed joints if necessary. Otherwise provide Type K from a single roll.
 2. Above Ground Piping:
 - a. Mains shall be run as shown on Drawings and shall be evenly pitched, 1 inch in 50 feet (0.2 percent).
 - b. Allowance for expansion shall be made in the installation of all piping so the usual variation in temperature will not cause undue stress at any point. Pipes shall be securely anchored where necessary to properly distribute expansion stresses.
 - c. System shall be arranged for complete drainage with 3/4 inch hose valves at low points.
 - d. Lines and risers shall be anchored as may be necessary to prevent noise or vibration when water is turned on or off.
 - e. Each branch and riser shall be separately valved, and all such valves shall be made accessible.
 - f. Where Drawings indicate fixtures to be furnished by others, provide all rough-in stops and supplies and connect such fixtures to the plumbing system.
 - g. Piping shall be balanced, vented and adjusted to provide proper circulation and to prevent hammer and thumping.
 - h. Joints in PEX piping shall be metal insert or metal compression fittings complying with UPC requirements.
 - i. Joints in copper piping shall be made with 95-5 tin antimony solder, stay brite solder by J.W. Harris Co. or by cadmium free brazing (Lead is not permitted), or by Pro Press fittings.
- B. Gravity Sanitary Piping:
 1. Ream all pipe to full diameter after cutting and thoroughly clean before erection. Run all piping as direct as possible, avoiding unnecessary offsets and conceal

pipng in finished rooms unless shown or specified otherwise. Arrange pipe lines to give ample room for pipe insulation.

2. All horizontal sanitary waste drainage and vent piping of 3 inches diameter and less shall be installed with a fall of not less than 1/4 inch per foot (2 percent). All horizontal sanitary drainage and vent piping larger than 3 inches shall be installed with a fall of not less than 1/8 inch per foot (1 percent). Where conditions do not permit building drains and sewers to be installed with a fall as great as that specified, then a lesser slope may be permitted provided the computed velocity will not be less than 2 feet per second.
3. All horizontal sewer piping shall be run with a fall not less than 1/4 inch per foot unless specifically indicated otherwise on the Drawings.
4. Vent pipes shall extend through the roof full size, with the exception that no vent through roof shall be less than 4 inches at the roof. Extend vents above roof minimum 12 inches or as required by local codes and ordinances or authority having jurisdiction. Vents through roof shall be flashed and counter-flashed using a manufactured neoprene rubber modular flashing system or with 4 pounds per square foot sheet lead flashing extending a minimum of 10 inches in all directions from the pipe and a minimum of 12 inches above roof. Counter-flashing shall be turned down inside the top of pipe and overlap lower flashing by 4 inches. To prevent movement in any direction, vent pipes through roof shall be supported both horizontally and vertically above last pipe joint before penetrating roof.
5. All sanitary piping located outside of the building specified under Division 15 work shall have a minimum of 36 inches of groundcover on top of the piping in all cases. If maintaining that depth of groundcover is not feasible because of the grades and landscaping specified in other sections, the Contractor shall install 4 feet-0 inch wide by 8 feet-0 inches, one inch "styrofoam" insulation boards on top of the piping. Fill shall be placed on top of the insulation sheets.

3.2. FIELD QUALITY CONTROL

A. Piping system leak tests:

1. Potable water piping:
 - a. After completion of the Work, but before final payment is made, Contractor shall run a test over a sufficient period of time to prove the proper capacity and performance of all apparatus, etc., and the system as a whole.
 - b. Pressure tests: make pressure tests in the presence of Owner's Representative, the Contractor's Representative, or the Authority Having Jurisdiction.
 - 1) Potable water service (below ground): after buried pipe is laid, joints completed, and trench partially backfilled, leaving the joints exposed for examination, newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected to a pressure test as specified in Section 15101 at points of reading. All pipe, joints, fittings, and valves shall be carefully examined during the open trench test. Joints, fittings or the portion of piping showing visible leakage shall be made tight or repaired. Cracked or defective pipe, fittings, or valves disclosed in the pressure test shall be repaired and retested until test results are satisfactory to Design Professional.
 - 2) Potable water service (above ground): all above ground piping shall be tested in accordance with Section 15101.
2. Sanitary sewer drainage piping:
 - a. Make pressure tests in the presence of the Owner's Representative.
 - b. All waste drainage piping, including branch bends and ferrule joints, shall be tested by closing all openings before any fixtures are set and filling entire

system with water, or by air pressure tests as required by Design Professional.

- B. Chlorination of domestic (potable) water system:
1. Chlorinate all new domestic hot and cold water lines to comply with local or state health officials, the Department of Public Works and with UPC requirements.
 2. This Work shall be witnessed by Design Professional, Owner's Representative, or the General Contractor's Representative.
 3. Chlorinating agent shall be applied at the start of a new line and shall be injected through a corporation cock or similar device, to insure complete chlorination of all pipe.
 4. Calcium hypochlorite shall be used where applicable and shall be commercial products such as H.T.H., Perchloron, or Mexochloron. The calcium hypochlorite must first be mixed to a homogeneous paste. The paste must contain approximately five (5) percent available chlorine by weight. The paste must then be thinned to a slurry and mixed with water to obtain a resultant consistency of 100 parts per million. This mixture must be fed into pipeline and retained for a one-hour contact period. All valves must then be opened in groups of three and water of 100 parts per million calcium chlorite concentration run through for a ten minute interval for each group of valves.
 5. After chlorination, all valves shall be opened and water run through to waste for a ten minute period or until the waste water indicated a residual of not over 0.25 parts per million.
 6. Have the local utility or an independent testing agency test and certify that the potable water system meets requirements of local health authorities before using for domestic service and upon completion of the system. A representative sample shall be obtained by the utility or testing agency at random outlets on the Project. If test sample does not prove to be potable, the entire Project's potable water system shall be sterilized again by the Contractor and retested, at no additional cost to Owner. The Contractor shall continue to sterilize and recheck system until the test samples prove to be potable.
 7. The Contractor shall test for and confirm the potable water system contains no Legionella.

3.3. ADJUSTMENT AND CLEANING

- A. Potable water piping: after piping is erected, thoroughly flush all piping and piping components before running pumps, or sterilizing the potable water system.

END OF SECTION 15410

**SECTION 15430
PLUMBING SPECIALTIES**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Provide all materials as hereinafter specified or shown and as necessary for the complete installation of the plumbing specialties.
- B. Reference Standards:
 - 1. Plumbing and Drainage Institute (PDI) Standard PDI-WH201, Uniform Plumbing Code, 2009.

1.2. SUBMITTALS

- A. Provide submittals for water hammer arrestors, floor drains, and backflow preventers.

PART 2. PRODUCTS

2.1. MATERIALS

- A. Drains:
 - 1. Provide Josam, Zurn, Wade or J.R. Smith.
 - 2. Floor Drains:
 - a. General Purpose Drains: Provide cast iron body, adjustable nickel bronze strainer, bottom outlet, double drainage flange with weep-holes. Provide with flashing clamp device for all floors above grade.
 - b. Mechanical Room Drain and Floor Sinks: Provide cast iron floor drain and floor sinks with double drainage flange and weep-holes, square body and loose set, heavy duty grate with removable 4 inches funnel, sediment bucket, bottom outlet and flashing clamp for all floors above grade.
 - c. Funnel Drains: Provide with an extended rim on strainer.
 - 3. Pressure relief valve drains shall comply with UPC ordinances.
- B. Fixture Carriers:
 - 1. Provide Zurn, Josam, Wade or J.R. Smith closet connections or fixture carriers.
 - 2. Wall Outlet Closets: Use Zurn Series Z-1203, Z-1204, Z-1207, Z-1208 or Z-1209 heavy cast iron fittings, face plate, foot support, coupling and mounting trim. Fittings to be single or double, right or left hand as applicable. Securely bolt carrier to floor and rigidly connect to waste piping. Finished installation shall be completely self-supporting and free of finished wall.
- C. Water hammer arrestors:
 - 1. Zurn Z-1700 "Shoktrol", Wade "Shokstop", Josam "Absorbo-tron", Sioux Chief or J.R. Smith "Hydrotrol" arrestors. Sizes as shown, designed in accordance with P.D.I. Standard WH 201 to prevent hammer in the piping systems.
 - 2. Water hammer arrestors shall be certified to function in accordance with PDI Standard PDI-WH-201 to limit surge pressure to 150 psig from a flow velocity of 10 fps at 60 psig through 50 feet of pipe same size as the water hammer arrestor.
 - a. Water hammer arrestor shall be constructed in one of the following manners.
 - 1) A non-ferrous elastic chamber contained in heavy steel casing with approved recoil dampers.
 - 2) Acetal piston. Three Buna-N O-rings, pressure-lubricated with Dow-Corning III Silicone Compound, FDA approved. Type L copper tube chamber, seamless spin reduction and closure, lead free solder joint.
- D. Vacuum breakers:
 - 1. Vacuum breakers for non-continuous pressure applications shall be Watts Regulator Company, Model No. 288A or Sloane Valve Company, No. V-350A with bronze body, chrome-plated in finished areas. Refer to drawings for special applications.
 - 2. Vacuum breakers for continuous pressure applications shall be Watts Regulator Company, No. 800.

- E. Cleanouts:
 - 1. Provide cleanouts manufactured by Josam, Zurn, Wade or J.R. Smith.
 - 2. Cleanouts shall be as follows:
 - a. Concealed, or exposed in unfinished area: Josam 58500-22.
 - b. Finished walls: Josam 58710-22 with Nickaloy top and satin finish.
 - c. Finished floors: Josam 58700-22 with Nickaloy top and satin finish.

- F. Backflow Preventer:
 - 1. Backflow preventer shall be a reduced pressure principle backflow type assembly consisting of two independently acting spring-loaded check valves together with an automatically operating pressure differential relief valve located between two check valves. First check valves shall reduce supply pressure of predetermined amount so that during normal flow and cessation of normal flow, pressure between the checks is less than supply pressure. In case of leakage of either check valve, differential relief valve shall discharge to atmosphere to maintain a pressure between checks, less than supply pressure. Unit shall include tightly closing shutoff valves located at each end of device, and shall be fitted with properly located test cocks and strainer. Operation shall be completely automatic. All internal parts of check valves and pressure differential relief valve shall be removable or replaceable without removal of backflow preventer from line. Total pressure drop through complete backflow assembly shall not exceed values given in the following table:

<u>Valve Size</u> <u>Discharge</u> (inches)	<u>Flow Rate</u> (gpm)	<u>Maximum Pressure Drop</u> (psi)	<u>Castrotophic</u> gpm @ 70psig
3/4	30	15	40
1	50	15	35
1-1/4	75	15	80
1-1/2	100	15	75
2	160	10	140
2-1/2	225	10	210
3	320	10	210
4	500	10	600
6	1000	8	600
8	1600	8	600
10	2300	8	600

- 2. Complete backflow assembly shall be by Wilkins, Watts, Hersey or Conbraco.
- 3. Provide size and number floor drains indicated on the drawings and/or specified by UPC 2009 to drain away the emergency drain flow from the back flow preventer.

- G. Strainers:
 - 1. Acceptable manufacturers for strainers:
 - a. Metraflex
 - b. Armstrong
 - c. Sarco
 - d. Apollo
 - e. Design Professional approved equivalent
 - 2. Strainers shall be of the "Y" type having Bronze bodies with blow-off tappings in screen covers. Bronze shall meet ASTM B62. Strainer shall have a screen of 20 mesh stainless steel, and shall be removable without disturbing piping. Gasket shall be of a non-asbestos fiber. Provide ball valve with nipple and cap for blow-off.
 - 3. Strainer shall be constructed for 150 psig design pressure.

PART 3. EXECUTION

3.1. INSTALLATION

A. Installation:

1. Closet and Floor Mounted Units Installation:

- a. Foot support shall be provided to meet specific job conditions, including floor depressions, if any. If manufacturer's standard foot support will not accommodate depression in floor, Contractor shall provide concrete fill to accommodate foot support furnished.
- b. Provide auxiliary face plate system Zurn Z-1212 when distance from centerline or plumbing chase to finished wall face of toilet room exceeds 14 inches for back to back installations and when distance from center line of carrier waste piping to finished wall face of toilet room exceeds 14 inches for single fixture installation. When auxiliary face plate system is required for back to back installations the main carrier system should be located within the allowable distance as described above to one wall, resulting in only one auxiliary face plate being required per back to back installation.

B. Cleanouts

1. Each horizontal drainage pipe shall be provided with cleanout at its upper terminal and each run of piping, that is more than fifty feet in total development length shall be provided with a cleanout for each fifty feet, or fraction thereof, in length of such piping. All slab constructed buildings and multiple buildings units shall be provided with an approved two way clean out fittings (Siamese) outside of building at the lower end of the building drain extended to grade. Building sewers shall be provided with a full size clean out within 2 feet of any building or structure. (Exterior or interior installation.) Cleanouts will not be required to be larger than 4 inches in diameter.

C. Flashing: all floor drains, except those in floors laid on ground or over crawl spaces, shall be installed with 4 pounds per square foot sheet lead flashing extending a minimum of 18 inches beyond the centerline dimension of drain in all directions between the structural and finished floor.

D. Vacuum breakers shall be provided on hose bibbs, hose outlets, and below the rim water supplies of all types, on all fixtures to which hoses and tubing can be connected, and at all locations specified or shown.

E. Backflow preventers shall be installed where indicated on the drawings.

F. Install strainers where indicated on the drawings.

G. Pressure relief valves.

1. Relief valves located inside a building shall be provided with a drain not smaller than the relief valve outlet, of galvanized steel, hard drawn copper piping and fittings, CPVC, or listed relief valve drain tube with fittings that will not reduce the internal bore of the pipe or tubing (straight lengths as opposed to coils) and shall extend from the valve to the outside of the building, with the end of the pipe not more than two (2) feet nor less than six (6) inches above the ground or the flood level of the area receiving the discharge and pointing downward. Such drains may terminate at the other approved locations. Relief valve drains shall not terminate in a building's crawl space. No part of such drain pipe shall be trapped or subject to freezing. The terminal end of the drain pipe shall not be threaded and the piping shall be secured.

END OF SECTION 15430

**SECTION 15434
DOMESTIC HOT WATER HEATER**

PART 1. GENERAL

1.1. SECTION INCLUDES:

- A. Point of use, instantaneous electric tankless water heater.

1.2. SUBMITTALS

- A. Submit shop drawings and catalog cuts indicating technical data necessary to evaluate the equipment. Include dimensions, wiring diagrams, performance data and other descriptive data.
- B. Submit operating and maintenance manual for system.

1.3. WARRANTY

- A. Submit a ten-year warranty for the coils, pressure vessel and anticipator. The unconditional and non-prorated warranty shall cover failure of the coils due to thermal shock, mechanical failure or erosion of the pressure vessel against leakage due to corrosion and of the anticipator against failure.

PART 2. PRODUCTS

2.1. MANUFACTURERS

- A. Acceptable manufacturers - electric "point of use" heaters:
 - 1. In sinkerator
 - 2. Renai
 - 3. Eemax
 - 4. Stiebel Eltron
 - 5. Rheem
 - 6. Bradford White
 - 7. Bosch
 - 8. Design Professional approved equivalent

2.2. MATERIALS

- A. Electric point of use, instantaneous heaters:
 - 1. Electric instantaneous tankless water heaters shall be designed for use with 120 VAC and shall be approved by Underwriters Laboratories. Heaters shall be suitable for a working pressure of 150 psig.
 - 2. The water heaters shall be insulated with polyurethane or fiberglass insulation. The energy efficiency of the heaters shall meet NAECA standards and International Energy Conservation Code minimum efficiency standards.
 - 3. The heater tanks interior surface shall be bronze.
 - 4. Provide tin coated, copper sheathed, immersion elements that have low watt density.
 - 5. Provide an unconditional one year warranty and certificate shall be attached to the water heater.
 - 6. Provide a drain valve.
 - 7. Provide adjustable, water temperature control with automatic over-heat safety device for safety protection.
 - 8. Provide unit mounted electrical disconnect switch, or grounded plug.

PART 3. EXECUTION

3.1. INSTALLATION

- A. Domestic water heater shall be installed to function as indicated on the drawings complete with all fittings and piping connections.
- B. Domestic hot water heater shall terminate in a hot drain cooling device per UPC 810.0.
- C. Provide hot water heating piping, power wiring and controls for the domestic water heaters.

END OF SECTION 15434

**SECTION 15440
PLUMBING FIXTURES**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Provide all Work as necessary for the complete installation of the plumbing fixtures and trim.
- B. This section shall cover general requirements and specified plumbing fixtures, Contractor furnished/Contractor installed.
- C. Provide plumbing rough in for Owner furnished, Contractor installed and Owner furnished/Owner installed plumbing fixtures.

1.2. QUALITY ASSURANCE

- A. Source quality control: plumbing fixtures and trim specified hereinafter shall be provided free of flaws and defects of any sort in material and workmanship and shall operate perfectly when installed in accordance with manufacturer's directions. The manufacturer shall agree to replace all or any part of the fixtures which show flaw or defect due to faulty manufacture.
- B. Reference standards: fixtures shall conform to current commercial standards for sanitary cast iron enameled ware and staple vitreous china plumbing fixtures and trim recommended by the U.S. Department of Commerce.
- C. All plumbing fixtures shall meet UPC requirements.
- D. Provide plumbing fixtures that meet the potable water efficiency specified.

1.3. PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protection of fixtures and trim: adequately protect the plumbing fixtures and accessories during construction. Replace at no cost to the Owner any fixture or accessory that is marred, scratched, defaced, or broken.

1.4. SUBMITTALS

- A. Provide submittals for all plumbing fixtures specified to be Contractor provided.

PART 2. PRODUCTS

2.1. MATERIALS

- A. General:
 1. Fixtures and associated supply valves and fittings shall be the standard product of one of the manufacturers listed with each fixture and comparable to the model listed.
 2. All plumbing fixtures shall be provided complete with all necessary trim and accessories to insure the proper installation and operation of each fixture. Trim and accessories shall include but not be limited to supply pipes, stops, drains, strainers, tailpieces, P-traps and bolt caps.
 3. Plumbing fixtures provided for use by the disabled shall be in compliance with the Americans With Disabilities Act (ADA).
- B. Water Closets.
 1. The following shall apply to standard water closets hereinafter specified unless noted otherwise.
 - a. Provide white vitreous china water closets with elongated bowls, lined flush tanks manufactured by Kohler, American Standard, Crane, Gerber, or Design Professional approved equivalent.
 - b. Provide color matched plastic seats with concealed hinge, open front elongated seat less cover and with concealed check. Seats shall be manufactured by Olsonite, Church, Beneke, Centoco, Bemis or by fixture manufacturer.
 2. Provide "dual flush" control for tank (1.6 gallons or 0.8 gallons per flush LEED requirement).
 3. Water Closet (Handicap). Furnish same as non-handicap, except mount at handicap height.

4. Flush mechanism and bowl design/construction shall clear solids on one maximum flush of dual flush tanks. Demonstrate operation and function to Design Professional.
5. Water Closet (Handicap). Furnish same as non-handicap, except mount at handicap height.

C. Lavatories.

1. The following trim shall apply to integrated counter lavatories hereinafter specified unless noted otherwise.
 - a. Provide white vitreous china lavatories with front overflows manufactured by Kohler, American Standard, Crane, Zurn, or Eljer or Design Professional approved equivalent.
 - b. Provide chrome plated brass supply fittings manufactured by Delta or Zurn. Provide wrist blade hot and cold handles for cold and hot water control and single sprout.
 - c. Provide with chrome plated brass supply pipes, 1/2 inch O.D. flexible risers and wheel handle, quarter turn closed to open, angle stops manufactured by Brasscraft or fixture manufacturer.
 - d. Provide with chrome plated, 1-1/4 inches cast brass tall pieces and P-traps with C.O. plugs manufactured by Dearborn Brass or fixture manufacturer.
 - e. Provide with flow limiting devices (aerators) to limit flows to 1.0 GPM.
 - f. Lav drains and hot water pipes shall be insulated or protected so that wheel-chair occupants cannot be burned. Provide protective lavatory enclosure around pipes.
 - (1) Provide ADA conforming lavatory piping insulation and piping covers.
 - (2) The enclosure shall cover the P-traps, hot and cold water valves and piping.
 - (3) The insulation guard kets shall be closed cell vinyl with special UV protection.
 - (4) The covering shall be white and shall be paintable.
 - (5) The shield shall be suitable for protection of wheel chair accessible lavatories.

D. Garbage Disposals - provide residential type disposals:

1. Residential type:
 - a. Garbage disposal shall be InSinkErator Evolution Essential series, continuous feed, single direction or Design Professional approved equivalent by Kenmote, Kitchen Aid or Badger.
 - b. The motor shall be 3/4 hp, split phase motor
 - c. Provide corrosion protection shield, self service wrench, stainless steel grinding elements with two stainless steel 360 degree swivel impellers.
 - d. Provide motor overload protector switch which requires manual resetting.
 - e. Provide water seal and stainless steel grinder
 - f. Provide a one-piece stainless steel stopper and cushioned outer splash baffle.
 - g. Provide a dishwasher drain connection and cushioned slip-joint where indicated

E. Stainless steel sinks

1. The following shall apply to stainless steel sinks hereinafter specified unless noted otherwise:
 - a. Provide sinks manufactured by Elkay, Moen or Just or Design Professional approved equivalent.
 - b. Sinks shall be self-rimming countertop type made of seamless 18 gage type 302 or 304 (18-8) stainless steel, with faucet deck below outside edge of sink, satin finish and fully undercoated.
 - c. Provide chrome plated brass supply fittings manufactured by Elkay, Just, American Standard, Kohler, Crane, Eljer, Delta, Moen, Zurn, Chicago Faucet, Cambridge Brass or T&S Brass.

- d. Provide sinks with chrome plated brass supply pipes, 1/2 inch outside diameter flexible risers and wheel handle, quarter turn closed to open, angle stops manufactured by Brasscraft or fixture manufacturer.
 - e. Provide sinks with chrome plated 1-1/2 inches cast brass tailpieces, P-traps and connecting piping manufactured by Dearborn Brass or fixture manufacturer unless specified to have acid waste. Provide PVC tailpiece for sinks specified to have acid waste.
 - f. Provide a dishwasher drain connection, garbage disposal and a cushioned slip-joint connection for sinks indicated on the plans.
 - g. Provide wrist blade handles for hot and cold water and gooseneck faucet spot. Provide flow limiting devices to limit flows to 2.5 GPM and aerators with maximum 1.0 GPM flow.
- F. Electric Water Coolers.
- 1. The following shall apply to water coolers hereinafter specified unless noted otherwise.
 - a. Provide water coolers manufactured by Haws, Halsey Taylor, Oasis, AcornAqua or Elkay.
 - b. Provide wall mounted water coolers with stainless steel top, anti-squirt chrome plated brass bubbler, strainer, pressure regulator, adjustable stream regulation, 20 gage stainless steel cabinet.
 - c. Unit capacities shall be based on cooling water from 80°F. to 50°F.
 - d. Provide with adjustable temperature control located inside cabinet.
 - e. Refrigeration system shall consist of a hermetically sealed air-cooled compressor removable for service, fan-cooled condenser and pre-cooler. System shall have built-in overload protection, operate on 115V, 60 HZ, 1 PH and have 3-wire grounding cord and plug, UL approval and a 5-year warranty on system.
 - f. All plumbing and electrical connections shall be concealed.
 - g. The water coolers shall be barrier free per ADA requirements, with "high and low" bowls.
 - h. Provide refrigerant 134A or R410A. Do not provide any CFC's or R-22.
- G. Janitor Sinks.
- 1. The following shall apply to floor mop sinks hereinafter specified unless noted otherwise.
 - a. Provide sinks manufactured by Advance, Mustee or Zurn 304 stainless steel.
 - b. Mop sink shall be 304 stainless steel.
 - c. Provide sink with cast brass drain outlet with removable stainless steel dome' strainer, cast integral, which provides for a calked connection of not less than 1 inch deep to a 3 inch pipe.
 - d. Provide sink with front drop cap, 20 gage 302 stainless steel one piece construction and 20 gage 304 stainless steel backsplash panels on number of sides as shown.
 - e. Provide supply fittings manufactured by Delta, Chicago Faucet, American Standard, Kohler, Crane or Eljer or Design Professional approved equivalent.
 - f. Provide rough-chrome finished exposed type double faucet with 1/2 inch supplies, stops, vacuum breaker and 5'-0 inches or rubber hose. Mount faucet stops at 24 inches above floor of sink.
- H. Hydrants:
- 1. General: Provide Josam, Zurn, Wade, J.R. Smith or Woodford nonfreeze 3/4 inch or 1 inch hose connection as shown, backflow prevention device, loose-key stop, brass casing and piping, with polished bronze face. Check wall thickness before ordering and install all (except yard and deck hydrants) 18 inches above grade.

PART 3. EXECUTION

3.1. INSTALLATION

- A. Plumbing fixtures shall be installed in a neat and workmanlike manner with proper connections to supply and drainage piping. Provide proper grounds for all fixtures requiring same.
- B. Voids between plumbing fixtures, mounting surfaces (except at ceramic tile surfaces) shall be filled with mildew resistant, latex calk. Self-rimming lavatories shall be set in mildew resistant, silicone sealant.
 - 1. Mildew resistant calk shall be non-toxic aquarium material.
- C. Mounting heights. Fixture mounting heights shall be as follows:

FIXTURE	STANDARD	HANDICAPPED
Water Closet	16 inches floor to seat	18 inches floor to seat
Water Closet Controls	Max 44 inches above floor	Max 44 inches above floor
Lavatory	31 inches floor to rim	34 inches floor to rim
Electric water cooler	40 inches floor to spout	36 inches floor to spout

- D. Provide "rough-ins" for Owner furnished Owner installed fixtures.

3.2. FIELD QUALITY CONTROL

- A. Plumbing fixture tests: water shall be turned on to all supply lines and all fixtures shall be demonstrated to operate properly.
- B. Contractor shall remove faucet strainers and clean them during the set up period.

END OF SECTION 15440

**SECTION 15545
CHEMICAL TREATMENT**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Provide additional glycol water mixture for the geothermal loop system.
- B. Provide the new water cleaning components (bypass feeder) for the geothermal loop system.

1.2. SUBMITTALS

- A. Certifications that chemical treatment proposed meets environmental requirements specified.

PART 2. PRODUCTS

2.1. MATERIALS

- A. Bypass feeders and slip stream filter:
 - 1. Bypass or slip stream feeders shall be High Capacity Filter Feeders, John Woods, J.L. Wingert or Neptune Chemical. Provide a 304 stainless steel basket, 2 ½ inch diameter by 19 inches long. Provide a bag filter for feeder at 25 micron level. Feeders shall be suitable for 200 psi at 200°F. Size shall be as indicated on the drawings.
 - 2. Provide a Dole Flow Control or similar flow control valve by FCI or Hayes with each bypass filter/feeder. The flow control valves shall be nickel plated and shall be at the capacity specified on the drawings.
 - 3. Provide the control associated with the bypass filter/feeder as indicated on the drawings.
 - 4. Provide one filter module for startup and flushing of the system. Remove the "dirty" module and replace with clean media. Turn over to the Owner two extra filter modules.

2.2. GEOTHERMAL LOOP SYSTEM TREATMENT

- A. Provide B&D Manufacturing, Inc. "GT" Flow Center – Multi-zone flow incorporated into the system as indicated on the drawings or similar system by J.L. Wingert, Neptune Chemical or John Wood.
- B. Contact information for B&D manufacturing is as follows.
 - 1. www.bdmfginc.com
 - a. Toll Free – 1.866.646.6724
 - b. Telephone – 1.712.652.3424
 - 2. Iowa representative
 - a. K&E of Dallas Center, IA
 - b. Office - 515.992.3328
 - c. Cell – 515.480.1417
- C. Provide the following:
 - 1. Size "C" Multi-zone GT Flow Seals
 - 2. Sealable lid.
 - 3. Stainless Steel MPT inlet connection
 - 4. Standing column of fluid in canister to pressurize pump inlets.
 - 5. Provide isolation ball valve in pump header to isolate connect.
 - 6. Provide pump connection; ball valve and check valve for each pump.
 - 7. Provide multiple parallel pumps as indicated on the drawings.
 - 8. Provide isolation valves on both sides of the pumps.
 - 9. Provide pumping manifold with factory assemble check valve, one isolation valve per circuit, and drain valve at end of the manifold.
 - 10. Provide unit at size indicated on the drawings.
 - 11. Flow center shall be suitable for adding chemical to geothermal heat pump loop.

PART 3. EXECUTION

3.1. INSTALLATION

- A. Install the filtration equipment in accordance with the manufacturer's recommendation and with requirements of the systems being treated.
- B. Refer to the geothermal flow diagrams and equipment schedules for specific flow requirements.
- C. Install the chemical treatment equipment in accordance with the manufacturer's recommendation and with requirements of the systems being treated.

END OF SECTION 15545

**SECTION 15782
HEAT PUMP**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Water source geothermal heat pumps for water to air heat pumps.
- B. Complete oil and refrigerant charge for each heat pump. DO NOT provide R-22 refrigerant, or any CFC refrigerant.
- C. Auxiliary electric heating coils shall be provided as back up emergency heating for units indicated.

1.2. STANDARDS

- A. Units shall have certified ratings complying with ARI Standard 430.
- B. All heat pumps shall meet requirements of the ASHRAE Refrigeration Safety Code and IMC.

1.3. QUALIFICATIONS

- A. Water to air units shall be by Florida Heat Pump; Arrangements, capacities and electrical characteristics as scheduled and/or indicated on the drawings. Design Professional approved equivalent models by Climate Master, Trane Company or McQuay will be allowed.
- B. All similar heat pumps supplied on the job shall be provided from a single manufacturer, unless different manufacturers are required for the different duties specified.
- C. Heat pump efficiencies and capacities shall be as specified on the drawings. Minimum heat pump efficiencies shall be as follows.
 - 1. Cooling EER minimum (per ARI rating) shall be 16.2 at entering water temperature of 59°F, and comply with IECC 2009 for ground source heat pumps rated less than 135,000 Btuhr cooling capacity.
 - 2. Heating COP minimum (per ARI rating) shall be 3.6 at 50°F entering water temperature and shall comply with IECC 2009 for ground source heat pumps rated less than 135,000 Btuhr cooling capacity.
 - 3. Minimum EER and COP shall be higher than these minimum levels if specified on the drawings, to meet utility company rebate requirements.

1.4. SUBMITTALS

- A. Submit shop drawings and/or catalog cuts providing dimensions, arrangements, clearance required construction materials, performance curves, capacity, horsepower, electrical characteristics and installation instructions.

PART 2. PRODUCTS

2.1. MATERIALS

- A. Water to Air units shall be factory built and assembled with arrangements as indicated on the drawings. Each unit shall be ARI certified per Standard 430. All heat pumps shall be UL listed. Each unit shall be fully run tested at the factory. All heat pumps shall comply with ASHRAE Refrigerant Safety Code requirements.
- B. The cabinet shall be fabricated from heavy gage galvanized steel and finished with a baked-on light paint. The interior shall be insulated with 1/2 inch thick, 1-1/2 pound density coated glass fiber. A full height access panel at the rear of the unit shall provide access to the fan and compressor sections. A separate front panel shall provide access to the fan motor. A separate front panel shall provide access to the compressor section and control box. A panel below the coil shall provide access to the evaporator sections. Unit shall have an insulated panel and drain pan separating the fan compartment from the compressor compartment. Units shall have a factory installed 2 inches thick filter bracket for side filter removal of Merv 11 filter. Refer to filter schedules for that unit filter requirement. Equipment room unit shall have a permanent filter frame with replaceable media as specified in Section 15885 for 2 inches thick filter (low or high efficiency). Unit shall have a galvanized steel painted drain pan with a 3/4 inch inside diameter drain connection extending thru the unit casing. Cabinet shall have separate holes and knockouts for entrance of line voltage and low voltage control wiring. Supply and return water connections shall be copper FPT fittings and shall protrude through the cabinet for connection to flexible hoses.

C. Refrigerant circuit:

1. Each unit shall have a sealed refrigerant circuit including a hermetic compressor, capillary expansion tubes, finned tube heat exchanger, reversing valve, water-to-refrigerant coaxial heat exchanger and safety controls.
2. Compressor shall be hermetic type with external vibration isolator mounts and thermal overload protection. The finned tube coil shall be constructed of aluminum fins bonded to copper tubes. The coaxial heat exchanger shall be constructed of a copper inner tube and a steel outer tube and shall be UL listed. The heat exchanger shall be rated for 400 psig on the water side and 450 psig on the refrigerant side.
3. Safety controls shall include a low suction temperature (freezestat) switch and a high refrigerant pressure switch to lock out compressor operation. Units four tons and above shall have a low refrigerant pressure switch for loss of charge protection. A low pressure switch shall not be permitted to replace a low suction temperature switch for freeze protection. Units shall be capable of being reset only by interrupting the power supply to the unit or by reset signal from the HVAC control system. Unit shall not be able to be reset from just the wall thermostat.
4. Water to Air units shall be capable of starting in an ambient condition of 40°F. with entering glycol/water at 28°F. with both air and water flow rates at the ARI rating conditions. Units shall be capable of operating with 110°F entering glycol loop temperatures without failure.
5. Units shall be capable of full operation with the propylene glycol/water mixture specified on the drawings or in the specifications for the heat pump loop.
6. Provide controls, refrigerant piping coil, and solenoid valves to provide hot gas reheat for humidity control for the de-humidification mode for units specified on the drawings.
7. **Heat pumps shall be designed for R410.** Do not provide heat pumps with any CFC refrigerant.

D. Electrical/Controls:

1. A control box shall be located within the unit and shall contain controls for compressor, reversing valve and fan motor operation and shall have a 50 VA transformer and a terminal block for low voltage field wiring connections. The control box shall be movable without access to the side of the unit.
2. Unit shall have time delay fuses or HACR circuit breaker for branch overcurrent protection. Provide a unit mounted disconnect at the power supply for the heat pump unit. Units shall have a single power connection for the heat pump.
3. Unit shall have programmable thermostats and humidistats controlling heat pump operation furnished by Section 15950. The unit control logic shall provide heating and cooling operation as required by the control inputs from the programmable controllers. The heat pump manufacturer or the Control Contractor shall provide the following:
 - a. The use of electronic type wall thermostats, humidistats, and other control signals (Control Contractor).
 - b. Fan operation simultaneous with the compressor (fan interlock) regardless of thermostat logic or fan only operation without compressor operation. (Control Contractor) Balancer shall set up speeds using transformer taps rather than "speed switch" for adjustment if adjustment is required for balancing.
 - c. Time delay compressor operation. Provide up to at least a two minute delay at start up signal from control system. Time delay shall be adjustable. (heat pump)
 - d. Delayed de-energization of the reversing valve or quiet reversing valve operation. (heat pump)
 - e. Compressor short cycle protection of a minimum of two minutes before restart is possible. (heat pump)
 - f. Single grounded wire connection for activation of the unoccupied, load shed or emergency shutdown modes. (Control Contractor)

- g. Night setback signal from the control system. (Control Contractor)
 - h. Override signal from space thermostat to override unoccupied mode for two hours. (Control Contractor)
 - i. Brown-out protection to suspend unit operation if the supply voltage drops below 80% of nominal. (heat pump)
 - j. Condensate overflow protection to suspend cooling operation in an event of a full drain pan. (heat pump) Provide remote alarm contact to control system for this occurrence.
 - k. Suspended compressor operation upon activation of the refrigerant pressure switches. (heat pump)
 - l. Cooling operation for 60 seconds upon activation of the low suction temperature (freezestat) switch - defrost cycle. (heat pump)
 - m. Method of defeating compressor, reversing valve and fan time delays for fast service diagnostics. (heat pump)
 - n. Provide circulator pumps for each heat pump. Circulators valve shall automatically energized to open to circulate the loop water through heat pump whenever compressor is energized. Provide wiring interlock connection through heat pump starting circuit. Provide compressor start time delay to allow for circulator to start before compressor starts. (Heat Pump Manufacturer coordination for heat pump and circulator.)
4. Provide motor starter and disconnect switches with each heat pump.
- E. Fan and motor assembly: unit shall have a direct drive centrifugal fan. The fan housing shall have a removable orifice ring to facilitate fan motor and fan wheel removal. The fan housing shall protrude through the cabinet to facilitate field duct connection. The fan motor shall be a multi-speed, PSC type with integral mounting brackets isolated from the fan housing and thermal overload protection. Units above one ton shall have a terminal strip mounted on the fan motor to facilitate motor speed change. The unit shall have a separate fan access panel for fan operation testing during compressor operation checkout.
 - F. Flexible hoses: each unit shall be supplied with two fire rated flexible hoses with ASTM ratings of Flame Spread 25, Fuel Contribution 25 and Smoke Density 50 for connection to unit and field piping. Hose shall be covered with braided stainless steel or braided copper. Hose assembly shall be rated at 200 psig.
 - G. Duct collar/filter rack: each unit shall be supplied with a return air duct collar/2 inch filter rack to accept a return air duct connection and a 1 inch filter frame. The side bracket shall allow for side filter removal without removing the ductwork. Provide an access door on the filter access. Refer to the drawings for details of the filter rack.

PART 3. EXECUTION

3.1. INSTALLATION

- A. Install units and make piping and duct connections as indicated on the drawings. Note that horizontal water to air units are serviced by removing entire unit; consequently, avoid placing units over lights, pipes or non-accessible ceilings.
- B. Extend condensate drain line with trap to nearest drain line or floor drain or condensate lift pump.
- C. Install flexible connectors in all duct connections to water to air units.
- D. All water to air units shall be installed with 18 inches long (minimum) flexible hose kits, sized per manufacturer, 200 psig working pressure, shut off valves, circulator manual air vent.
- E. Prior to connecting heat pumps to loop, use flexible hose to by-pass supply to return and circulate system and flush and treat with pre-cleaner as specified in Section 15060.
- F. Provide each heat pump with a complete refrigerant and oil change. Provide checkout and certificate that the heat pumps are fully charged.
- G. Provide condensate lift pumps for water to air heat pumps required to have cooling condensate lifted.
- H. Set up stages of heating and cooling and hot gas reheat in accordance with control sequences specified.

- I. Provide drain pan under the entire heat pump apparatus to catch any incidental overflow of the heat pumps located in the attic.

3.2. START UP

- A. Provide factory representative start up of the water to air heat pumps.

END OF SECTION 15782

**SECTION 15815
HUMIDITY CONTROL EQUIPMENT**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Electric Immersion heater steam humidifiers
- B. Slip stream de-humidifiers.

1.2. SUBMITTALS

- A. Submit shop drawings indicating construction, installation and operating requirements.
- B. Submit operating and maintenance manuals for the humidifiers.
- C. Provide system demonstrations of de-humidifiers and humidifiers.

PART 2. PRODUCTS

2.1. HUMIDIFIERS

- A. Acceptable humidifier manufacturers:
 - 1. April Aire
 - 2. Neptronic
 - 3. Hermidifier
 - 4. Pure Humidific
- B. Basis of design
 - 1. April Aire Model 800
- C. Materials
 - 1. The humidifier shall be electric immersion element type humidifier. Humidifier shall be suitable for use with soft water.
 - 2. The humidifier shall be tested and approved by ETL/ETL-C Testing Laboratories, Inc. (ETL #47294).
 - 3. The humidifier shall have an evaporator reservoir with a gasket sealed cover which is capable of operating at pressures of at least 19 inches (W.C.) without steam or water leaks. The reservoir shall be made of type 304 stainless steel with welded joints.
 - 4. The humidifier shall be designed to facilitate easy removal of the heat element and heat exchanger for periodic scale removal and inspection. The cover and heat exchanger shall be secured to the unit by the use of quick release clamps. The heat exchanger shall be removable from the side of the humidifier without disturbing the cover or injection tube systems steam supply piping.
 - 5. The humidifier shall be provide with support legs made of 1 ¼ inch x 1 ¼ inch x ¼ inches angle iron and painted with enamel gray paint. Distance from humidifier bottom to floor shall be 24 inches.
 - 6. Unit shall be covered (except exchanger faceplate) with ¾ inch thick fiberglass duct insulation. Insulation material shall have aluminum facing.
 - 7. The heat exchanger shall be constructed of type 304 stainless steel with 2 inches round heat transfer tubes. Tubes shall be self cleaning via expansion and contraction of tubes. Coating of tubes is not required.
 - 8. The humidifier shall require only 2 sides for service access.
 - 9. An adjustable surface water flusher shall be included to drain away a portion of the water upon each refill cycle. This will allow mineral deposits produced by earlier evaporation cycles to be removed.
 - 10. A brass body, solenoid operated water fill valve shall be factory mounted on the top near the front of the humidifier reservoir. The fill valve shall be located to allow a minimum water gap of 1 ½ inches. An inline strainer shall be factory mounted upstream of the fill valve to remove any water born particulate matter before the humidifier fill valve. The water strainer shall have a removable screen to permit periodic inspection and cleaning.
 - 11. The humidifier shall be provided with an ETL listed JIC NEMA 1 control cabinet, shipped factory mounted and wired to the reservoir. The control cabinet shall be

made of 14 gauge steel with ANSI 61 gray polyester powder coating, continuous hinge and oil resistant gasket. The panel shall include a factory wired sub panel with electric element interlock water level control, fused control circuit transformer, numbered terminal block and main power fuse(s).

12. The control system shall maintain humidification during the fill cycle to maintain a consistent relative humidity.
13. An INTAC programmable electronic microprocessor humidifier control system shall be mounted and pre-wired to the humidifier control panel door. The INTAC controller shall provide digital display of all humidifier functions. The unit mounted control shall interface with the building automation system as specified in the control sequence.
14. Provide variable air volume anticipation control.
15. Provide cold weather relative humidity reset based on outside air temperature. The two way solenoid valves which serve each injection tube set shall be interlocked with the respective system air flow switch to prohibit opening on a call for humidification unless the associated air handling unit supply fan or heat pump is proven in operation.
16. Provide make up water to the humidifier and an isolation cock or valve for servicing.
17. Provide unit mounted electrical disconnect at the humidifier control panel.
18. Provide the following to interlock for the humidifier operation.
 - a. Air flow permissive interlock. Humidifier valve shall not open if there is not air flow proven by an air flow switch. This interlock shall have an automatic reset when air flow is restarted.
 - b. High limit relative humidity interlock shall close humidifier solenoid valve if duct humidity level sensor setpoint is exceeded, (Setpoint 85% RH). This interlock shall provide an alarm and have an automatic reset.
 - c. Duct water sensor shall close humidifier if water is sensed in the ductwork. This interlock shall provide an alarm and require a manual reset. Duct water sensor shall be large enough to sense water in a two square feet area at the bottom of the duct.
 - d. Interlock with outside air temperature that does not allow humidification at outside air temperature above 50°F.

2.2. DEHUMIDIFIER

- A. Provide dehumidifier by Aprilaire or Design Professional approved equal by Honeywell Tru-Dry, Neptonic or Pure Humidific.
- B. Provide the following for the de-humidifier.
 1. Thermostatic Expansion Valve(TXV) shall modulate the flow of refrigerant entering the evaporator coil at the same rate as the refrigerant being boiled off in the evaporator coil. The TXV also shall provide the necessary pressure drop within the system to separate the high and low pressure sides of the system.
 2. The cabinet of the Model 1700 shall be fully insulated with a 1 inch insulation that is designed to reduce unit operating sound levels, prevent condensation from forming on the exterior of the unit, and prevent the possibility of heat gain when the unit is located in higher temperature locations, such as mechanical rooms or above ceilings.
 3. The evaporator coil shall have a lanced fin and double row tube design, giving the Model 1700 better surface contact with the moisture-laden air. The R-410 refrigerant within the coil shall provide the maximum temperature differential required for the air to reach dewpoint sooner, removing more moisture. These features shall provide the unit with a 60% SHR rating at 80°F and 60% RH.
 4. The Model 1700 shall be controlled as specified on project drawings.
 5. Inlet and discharge connections shall be designed for 8 inches insulated, standard round or spiral duct.

6. The unit shall be equipped with a safety disconnect switch that shall completely shut the power off during any service or maintenance.
7. The internal blower shall be a direct drive forward curved blower designed to deliver the air flow required for air sampling and distribution. The unit shall be designed to deliver the proper amount of air quietly and efficiently.
8. Provide condensate drains to floor drain or equipment space drain located on the drawings.

PART 3. EXECUTION

3.1. INSTALLATION

- A. Install humidifiers and de-humidifiers as indicated on the drawings and in strict compliance with the manufacturer's requirements.

3.2. START UP

- A. Provide start up for the humidifiers and de-humidifiers.
- B. Do not start up humidifier and let humidifiers operate without confirming that all water safety devices function as specified to prevent duct flooding.

END OF SECTION 15815

**SECTION 15830
TERMINAL UNITS****PART 1. GENERAL**

1.1. SECTION INCLUDES

- A. Terminal units including:
 - 1. Baseboard Heaters

1.2. SUBMITTALS

- A. Submit shop drawings and/or catalog cuts indicating technical data necessary to evaluate the equipment, to include color charts, dimensions, wiring diagrams, performance data and other descriptive data necessary to describe fully the terminal units.
- B. Submit operating and maintenance manuals for all terminal units.

PART 2. PRODUCTS

2.1. MANUFACTURERS

- A. Acceptable manufacturers – Baseboard heaters
 - 1. Markel
 - 2. Chromalox
 - 3. Raywall
 - 4. Berko
 - 5. Design Professional approved equivalent

2.2. TERMINAL UNITS

- A. Units shall have capacities and ratings and shall be of arrangement as scheduled on the drawings.
- B. Units to be installed in finished areas to be furnished with bonderized, phosphatized, flow-coated baked-on primer with spray applied baked-on enamel in color selected by the Design Professional.

2.3. BASE BOARD HEATERS

- A. All heaters shall be constructed of roll formed steel and painted with a powder coat textured finish. Use industrial enclosures for units to be installed inside geothermal vaults. 2900 "C" series commercial base boards shall be Bankers Bronze color.
- B. Quick connect cable clamps shall be located in right and left junction boxes to restrain incoming field wiring without the need for additional hardware.
- C. All base boards shall be 6 inches high and extend 2-1/2 inches from the wall.
- D. All base boards shall be constructed with a full length wireway along the back of the heater. A wireway cover shall be factory installed on all C Series commercial base boards.
- E. Integral thermostats shall utilize the base board junction box cover for inbuilt thermostat applications.
- F. A 6 inches ground lead wire shall be provided in both right and left junction boxes allowing for easier ground connection.
- G. The "C" Series 2900 Baseboard shall have long-lasting stainless steel element rod with its aluminum chimney designed fins. The fins shall be mechanically staked to the element rod to allow excellent transfer and dissipation of heat from the heater into the room.
- H. An over-temperature thermal limit shall extend the entire length of the heated area to serve as a safety device in case of an air flow blockage in front of the heater.
- I. All units shall have 20 gage junction boxes at both ends of the heater. The back of the heater shall be constructed of 22 gage roll formed steel, while the front panel shall be 18 gage.
- J. All commercial base boards shall have wire guards installed every 2 inches over the heat outlet area and underneath the element.
- K. The heater shall be mounted to the wall by using keyhole knockouts every 4 inches at the back of the heater.
- L. Provide accessories indicated on the drawings.
- M. The base boards shall be UL listed.

2.4. CAPACITY

- A. All unit capacities shall be based upon using the voltages specified on the drawings and in the specifications.

PART 3. EXECUTION

3.1. INSTALLATION

- A. Install units and make wiring connection as indicated on the drawings.
- B. Install miscellaneous electrical devices as required for complete installation.
- C. Controls: install devices furnished by the manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical contractor for power wiring.
 - 1. Verify that wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 16. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

END OF SECTION 15830

SECTION 15865
ENERGY RECOVERY VENTILATORS

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Provide the energy recovery section fan and plate/frame section.

1.2. SUBMITTALS

- A. Submit manufacturer's catalog cuts showing complete descriptive data.
- B. Submit operating and maintenance manuals for the units.

PART 2. PRODUCTS

2.1. MANUFACTURERS

- A. Acceptable Recovery Unit Manufacturers:
 - 1. FanTech units – SER 3204. Design Basis
 - 2. Loosnay for units specified for inside building locations.
 - 3. Renew Air specified for inside or outside building locations. Loosnay shall provide Renew Air energy recovery cores.
 - 4. Design Professional approved equivalent

2.2. MATERIALS

- A. Energy Recovery Ventilation – Plate and Frame Heat Exchanger/ Supply / Exhaust Fans
 - 1. Fixed plate energy exchange. Module shall be fixed plate cross flow construction with no moving parts.
 - 2. Energy transfer shall be sensible heat and latent by change in state.
 - 3. Unit shall be capable of operating without condensation, or drains shall be provided.
 - 4. The energy recovery system shall include powered exhaust to match the powered supply to avoid the requirements for separate space exhaust systems unless specifically indicated.
 - 5. Provide fans, fan motors, filters and dampers specified.
 - 6. Provide defrost controls, drain pan and drain connectors.
 - 7. Provide unit mounted disconnect switches for fan motors.
 - 8. Capacities and efficiencies of the units shall be as specified on the drawings.
 - 9. Fan shall be constant speed.
 - 10. Provide washable, cleanable filters for both outside and exhaust air sides.

PART 3. EXECUTION

3.1. INSTALLATION

- A. Install the energy recovery ventilators and energy recovery sections in accordance with the manufacturer's instructions.
- B. Route defrost drain line to nearest floor drain.

3.2. BALANCING AND SET UP

- A. Set up the separate supply and exhaust flow rates to operate in accordance with the control sequence specified.
- B. Remove the supply air intake (outside cold air stream) filters during cold weather to prevent filter freeze up. Replace filter in air intake with onset of warm weather.
- C. Provide manufacturer's representative start up of the energy recovery units.

END OF SECTION 15865

**SECTION 15885
AIR CLEANING**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Providing all materials as specified or shown on the drawings for the cleaning and filtering of the air supply for the heat pumps. The energy recovery units shall be supplied with cleanable filters.

1.2. QUALITY ASSURANCE

- A. All panel and extended surface air filters shall be tested and rated in accordance with the ASHRAE Test Method (Standard 52-76).

1.3. SUBMITTALS

- A. Submit shop drawings for air filters.

PART 2. PRODUCTS

2.1. MANUFACTURERS

- A. Acceptable manufacturers – pre-filters, final filters, and housings:
 - 1. American Air Filter
 - 2. Cambridge/Farr
 - 3. Flanders
 - 4. Koch
 - 5. Basis of design - Cambridge/Farr

2.2. MATERIALS

- A. Replaceable filters
 - 1. Replaceable type panel filters - glass fiber filtering pleated media, not less than 2 inches thick with a minimum efficiency of Merv 8 or Merv 11. Replaceable filter shall be UL class 2.
 - 2. Filter efficiencies shall be average atmospheric dust spot efficiencies tested in accordance with ARI 850.
 - 3. Filter frames shall be high wet strength beverage board.
- B. Unit filter bank housing:
 - 1. Housing and access doors shall be designed to operate at the same pressures as specified for the air handling unit.
 - 2. Housing shall be constructed of 4 inch wide flanges, heavy duty corner posts, and vertical supports spaced a maximum of every two feet of filter width. It is constructed of heavy gauge galvanized steel. Duct connections shall be flanged type.
 - 3. Housings shall be provided with an access door on each end. All doors shall have neoprene rubber gaskets to ensure proper seal. Large, quick acting, spring loaded cast aluminum latches shall be provided for the access door along with plated hinges to resist corrosion. Access door hinges, and latches shall be rated for operating pressure of fan.
 - 4. Neoprene gasketing shall be used to provide a tight seal between filters and filter housing to ensure that no air bypasses the filter media.
 - 5. Filter housing shall be furnished with a filter module lever locking or clamping mechanism that is adjustable which will accommodate dimensional variations in filter modules from different manufacturer.
 - 6. Refer to heat pump drawings for filter box requirements.

PART 3. EXECUTION

3.1. INSTALLATION

- A. Install all air cleaning devices in accordance with the manufacturers recommendations.
- B. Provide one extra (spare) set of filter modules for all the filters and turn over to the Owner for the new unit. This set of filters is in addition both to the construction period filters and the initial set of clean filters installed in the air handling systems when the project is completed prior to Owner occupancy. Provide the Owner with the "spare" set of filter modules within 30 days of the substantial completion date.

- C. Install temporary construction period and permanent filters in accordance with sequences specified in Section 15010 for duct and equipment cleaning. These "cleaning operation" filters shall be in addition to the spare set of filters specified to be turned over to the Owner.

END OF SECTION 15885

**SECTION 15890
DUCTWORK**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. This Section includes furnishing and installing all material for the complete installation of the following:
 - 1. All ductwork shown on the Drawings for the complete heating, air conditioning, exhaust, and ventilating systems.
 - 2. All flexible duct.

1.2. QUALITY ASSURANCE

- A. Reference Standards:
 - 1. National Fire Protection Association (NFPA).
 - a. NFPA 90-A, "Air Conditioning and Ventilating Systems."
 - 2. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - a. "HVAC Duct Manual" in this Specification shall mean the first edition of the "HVAC Duct Construction Standards, Metal and Flexible."
 - b. "Balancing and Adjustment Manual" in this Specification shall mean the first edition of the "Manual for the Balancing and Adjustment of Air Distribution System."
 - 3. International Building Codes
 - a. Mechanical Code, 2009 edition.
 - b. Energy Conservation Code, 2009 Edition.

1.3. SUBMITTALS

- A. Submit duct fabrication drawings showing sizes, location, materials and pressure classification as minimum.
- B. The Contractor shall not fabricate or install any ductwork until the ductwork fabrication drawings have been submitted and reviewed and accepted by the Design Professional.

PART 2. PRODUCTS

2.1. MATERIALS

- A. Ductwork construction.
 - 1. General.
 - a. Ductwork construction shall, as a minimum, conform to NFPA Standard 90-A, the International Mechanical Code, International Energy Code Conservation Code, and the SMACNA HVAC Duct Manual. Ducts shall be constructed of galvanized steel unless otherwise specified or shown on the Drawings, to be some other material.
 - b. The size of the ducts indicated on the Drawings shall be net inside dimensions.
 - c. The duct pressure class specifications shown on the Drawings are explained in Figure 1-1 of the SMACNA HVAC Duct Manual.
 - d. Ducts shall be sealed in accordance with Table 1-2 of SMACNA or in accordance with Section 503.2.7 of the 2009 IECC whichever requirements are more stringent.
 - e. All ductwork shall be substantially and neatly supported so that horizontal ducts are without sag or sway, vertical ducts are without buckle and all ducts are free from the possibility of deformation, collapse, or vibration.
 - 2. Rectangular ductwork.
 - a. Ducts shall be constructed and reinforced in accordance with Tables 1-3 through 1-13.
 - b. Tie rod attachments shall be in accordance with SMACNA Figures 1-2 and t-3.
 - c. Aluminum duct shall be constructed in accordance with Tables 1-14 through 1-16.
 - d. Duct joints and seams shall be in accordance with Figures 1-4 through 1-18.
 - e. Fittings and other construction.

- 1) Duct fittings, branches, and connections shall be in accordance with Figures 2-1 through 2-11. All square throat elbows shall have turning vanes. A Type RE 4 elbow as shown in Figure 2-2 and a straight tap for rectangular ductwork as shown in Figure 2-8 is not permitted.
 - 2) Duct access doors shall be in accordance with Figures 2-12 and 2-13. Doors shall be adequately sized for ease of maintenance of concealed items. Insulate access doors where ducts are insulated with same insulation as on ductwork.
 - 3) Volume dampers shall be in accordance with Figures 2-14 and 2-15.
 - 4) Grille, register, and diffuser connections shall be in accordance with Figures, 2-16 through 2-18.
 - 5) Flexible connections at fans shall be in accordance with Figure 2-19.
 - f. Flexible duct liner shall be installed in accordance with Figures 2-22 through 2-25.
3. Round and oval ductwork.
 - a. Round ducts shall be constructed in accordance with Tables 3-2 and 3-3.
 - 1) Seams and joints shall be in accordance with Figures 3-1 and 3-2.
 - 2) Fittings shall be in accordance with Table 3-1, Figure 3-3 and the following list of approved fittings shown on Figure 3-4: 90 degree Tee Fitting, 90 degree Tap, 90 degree Tee with Oval to Round Tap, and Figure 3-5: Conical Tee Fitting, Conical Tap, Wye Fitting, Conical Tee and Reducer Fitting, and Alternate Arrangement.
 - 3) Flat oval ductwork construction shall be in accordance with Table 3-4. Fittings shall be in accordance with Figure 3-6, or as manufactured by United McGill, Semco, Norlock, Lindlab or Design Professional approved equivalent.
 4. Hangers and supports.
 - a. Rigid round, rectangular and flat oval metal ducts shall be installed with support systems in accordance with Figures 4-1 through 4-9 and Tables 4-1 through 4-3. Horizontal ducts shall have a support within 24 inches of each elbow and within 48 inches of each branch intersection.
- B. Flexible ductwork.
1. Provide flexible duct as shown and make connections between ducts and ceiling diffusers with a minimum of 12 inches of flexible duct. No flexible duct shall be longer than 4'-0 inches.
 2. Flexible ductwork shall be of spiral construction composed of a corrosion resistant metal supporting spiral and a coated fabric with a metal or mineral base. Flexible duct connectors shall be listed by UL and shall have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50. Operating temperature range shall be 0°F. to 200°F. Operating pressure shall be negative 0.5 inch to positive 10 inches W.G.
 3. Where either acoustical duct liner or exterior insulation is shown or specified for duct systems, provide factory pre-insulated material for all flexible ductwork in the system consisting of a galvanized spring bonded to the interior liner, 1 inch thick. 0.75 pounds/cubic foot fiberglass insulation and a laminated vapor barrier jacket consisting of fiberglass reinforced metalized film or vinyl or synthetic film. Furnish Porter Portoduct Type TK or Thermaflex Type M-KC.
 4. Provide bare flexible duct for systems not requiring acoustical lining or exterior insulation, Porter Portoduct Type T, Thermaflex Type S-TL, or Wiremold Type 57.
 5. Flexible duct shall be supported in accordance with Figures 3-9 and 3-10 of the HVAC Duct Manual.
- C. Field erected casing and plenums.
1. Equipment housings shall be provided for the air conditioning system as shown on the Drawings and as hereinafter specified. All sheet metal and steel framing material shall be galvanized, except that G90 coated galvanized steel shall be

used in all chambers with high probability of moisture presence such as outside air intake plenums or air-handler discharge plenums.

- a. Entire casings or plenums shall be made airtight, suitably braced with structural iron members and free from breathing or vibration. Housing shall terminate at masonry walls and at floors with angles and a sponge rubber gasket. All welds on casing interiors shall be painted. Casings and plenums shall be constructed to withstand 133 percent of rated pressure without structural failure. Wall and roof deflection at rated pressure shall not exceed 1/8 inch per foot of width.
 - b. Casings or plenums shall be single wall and internally insulated with rigid insulation board to provide an overall U-value of 0.10 BTU/h/ft².°F.
 - c. Flexible connections shall be placed between fan and casings, where applicable.
 - d. All casings on the suction side of the fan shall be the pressure classification equal to the negative pressure at fan shutoff. Casing on fan discharge shall be of the designated pressure class.
2. Casings and plenums shall be constructed in accordance with Figures 6-1 through 6-8 and Table 6-1 of the HVAC Duct Manual.
 3. Pipe penetrations shall be sealed to prevent air leakage and condensation movement through the seal. Penetrations shall be in accordance with Figure 6-10.
- D. Access doors: Access doors shall be provided where shown and as required for access to all mechanical equipment mounted inside ductwork. Doors shall be complete with hinges, gaskets and "Ventlok" No. 260 latches manufactured by Ventfabrics, Inc., Chicago, Illinois or Young Regulator Company. Doors shall be made airtight and shall swing opposing the plenum pressure. Doors in casings shall be constructed in accordance with Figures 6-11 and 6-12 and Table 6-2. Doors shall be insulated where casings are insulated.

PART 3. EXECUTION

3.1. INSTALLATION

A. Ductwork construction - general.

1. Adhere to Drawings as closely as possible. The Contractor may vary run and shape of ducts and make offsets during progress of work, if required to meet structural or other interference.
2. Install ductwork in adherence to ceiling height schedules indicated. Consult with other trades, and in conjunction with them, establish necessary space requirements for each trade so as to maintain required clearances. Where no ceiling height is stated, ductwork shall have a minimum clearance of 9'-8 inches, or as high as possible above the floor.

3.2. ADJUSTMENT AND CLEANING

A. Balancing and Adjusting.

1. Make adjustments of the mechanical equipment in accordance with the plans and Specifications as directed by the air balance and testing agency if it is found that any portion of the Work has not been properly installed for accomplishing the testing and balancing as called for in the specifications.

- B. Clean all duct interiors of all debris during assembly, prior to closing up various sections, and prior to operating any fan associated with a particular duct system in accordance with Section 15010.

3.3. FIELD QUALITY CONTROL

A. Leakage test - ductwork

1. Test all regular sheet metal duct, regardless of what is specified in SMACNA:
 - a. Test equipment - use equipment arranged as recommended by test and balance agency specified in Section 15990.
 - b. Field test procedure.
 - 1) Seal all openings in duct section to be tested.

- 2) Connect test apparatus to test section of duct, using a flexible duct connection or hose.
 - 3) Close damper or blower suction side to prevent excessive build up of pressure.
 - 4) Start blower and gradually open damper on suction side of blower.
 - 5) Build up pressure in duct test section to the pressure equal to the maximum operating pressure indicated on the drawings for the system being tested.
 - 6) Read indicated pressure or instrument that is connected to section of duct under test.
 - 7) Maintain this pressure for 10 minutes, which will indicate audible leaks.
 - 8) Repair all visual and audible leaks in duct. Shut down blower and release pressure when making repairs.
 - 9) Upon completion of repairs, build up pressure to design operating pressure, and read leakage pressure on instrument connected across test apparatus orifice Plate Figure 1.
 - 10) Leakage cfm is read by consulting chart calibrated with orifice diameter. If no leakage exists, zero pressure differential will be indicated.
- B. Engage the testing agency specified in Section 15990 to verify the leakage test procedure of all ductwork and submit a certification attesting to this review. Make arrangements to coordinate the field test of installed sections of ductwork. Test results and verification shall be recorded and submitted on AABC Standard Test Form #32267.
1. Tested sections of ductwork shall be visually marked by testers with certification sticker and initials of field test inspector. Tests shall be made before duct sections are concealed or insulated.
 2. Representative sample testing will not be acceptable.
- C. Duct leakage acceptance levels and report.
1. Duct leakage acceptance level shall be less than SMACNA Leakage class 6 for everything.
 2. Test all sheet metal duct systems and provide a leak test report showing methods, test pressures and results.

END OF SECTION 15890

**SECTION 15910
DUCTWORK ACCESSORIES**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. This Section includes air distribution specialties and ductwork accessories complete for air distribution systems.

1.2. SUBMITTALS

- A. Provide submittals on all material furnished.

PART 2. PRODUCTS

2.1. MATERIALS

- A. Flexible Connections. 6 inch flexible connections shall be installed between all rigid ductwork or casing and all air handling/in-line fan equipment not integrally provided with vibration isolation within fan casing except for connections in curb mounted exhaust fans and terminal units. Connections shall be of asbestos-free fireproof material and suitable for temperatures and pressures involved. Connection materials shall not exceed a factory tested flame spread rating of 25 or a smoke developed rating of 50. At least 1 inch slack shall be allowed in these connections to insure that no vibration is transmitted from fan to ductwork. Fabric shall either be folded in with metal or attached with metal collar frames at each end to prevent air leakage. Furnish Ventfabrics "Ventglass."
- B. Turning Vanes. Turning vanes shall be installed in all mitered duct elbows and where shown on Drawings. All turning vanes shall be double thickness type per the SMACNA-HVAC Duct Construction Manual.
- C. Volume dampers: Volume dampers shall be provided at take off for flex duct and where shown on drawings. Volume dampers shall be two metal gages heavier than the duct in which they are installed and shall be reinforced to prevent vibration and noise. All volume dampers occurring in concealed ductwork, except those above removable ceilings, shall be installed with shafts vertical. In ducts over 14 inches in width with vertical shafts, use multilouvered opposed blade dampers manufactured by Airstream Products, Ruskin, Nailor Industries, NCA Manufacturing or United Aire. For accessible dampers use Young No. 403 damper regulators and No. 656 end bearings. Dampers in rooms with other than removable type ceilings shall have Young No. 301 concealed damper regulators.
- D. Diffusers, Registers, Grilles:
 - 1. General Requirements.
 - a. Provide all diffusers, registers and grilles as indicated on the Drawings. Neck sizes, face sizes, CFM airflow capacities, maximum allowable noise criteria (NC Level) and air pressure drop shall be as specified on the Drawings.
 - b. Select diffusers and registers which, when adjusted and balanced by the testing and balancing contractor, will provide uniform air distribution over the indicated throw area at the installed height without causing excessive or annoying drafts in the occupiable zones within their coverage. Maximum terminal velocities in the occupiable zones shall not exceed 75 feet per minute unless specifically indicated otherwise on the drawings.
 - 2. Materials.
 - a. Provide diffusers, registers and grilles of corrosion-free steel construction except where noted or specified otherwise. Mitered joints, where required, shall be maintained straight and free from visible gaps, butted tightly together under all possible mounting conditions by concealed tack welding or concealed welded plate connections.
 - b. Provide diffusers, registers and grille of all-aluminum construction only in "wet areas" subject to corrosion; such as locker, shower and toilet areas. Notwithstanding the above, provide all bar and slot linear devices of extruded aluminum construction, regardless of location unless noted otherwise on the drawings or unless specified otherwise for security reasons.
 - 3. Frames and Borders.

- a. Provide diffusers, registers and grilles with mounting frames and applicable borders as indicated on the Drawings.
 - b. For grid-T lay-in ceilings, provide diffusers, registers and grilles with suitable outer dimensions compatible with a 24 inches x 24 inches ceiling grid module; include extension panels if applicable.
 - c. Provide narrow width (5/8 inch to 1 inch), shallow thickness, surface-mounted frames and/or borders for all drywall surface-mounted devices, unless noted otherwise on the Drawings.
 - d. Provide flush plaster frames with concealed mounting/fastening for all (wet work) plaster ceiling and wall applications.
 - e. Provide heavy duty reinforced frames and borders for all floor-mounted applications. Such devices shall be capable of incurring normal foot traffic live loads without causing deformation or visible deflection. Frames and/or borders shall be suitable for the floor surface in which they are to be installed and shall be rigidly attached to prevent "rocking" and slippage movement.
 - f. Frames and borders require acceptance of the Design Professional during shop drawing review.
4. Finishes.
- a. Unless specified or otherwise indicated, diffusers, registers and grilles shall have an off-white, factory applied enamel paint finish which blends with a variety of grid-T ceiling suspension systems. Anodized, baked epoxy, and special color/paint finishes shall be as indicated on the Drawings.
 - b. Refer to Design Professionals Drawings to verify color requirements prior to placing factory orders. Notify the Design Professional regarding any apparent discrepancies on color finishes.
5. Accessories.
- a. Provide screwdriver or lever operated, worm gear actuated, opposed blade or butterfly volume dampers only on ceiling supply units as specifically noted or indicated on the Drawings and in the necks or branch take-off duct of all single diffusers which are tapped directly into a main trunk duct. Under conditions such that the diffuser/register branch tap duct is less than one duct diameter provide a diffuser collar-mounted volume damper to permit balancing. Under conditions where the single diffuser branch tap is longer than one duct diameter, provide volume damper in branch takeoff duct as close to main trunk duct as possible. Provide manufactured dampers which either spring clip or screw-mount into the unit collar. Dampers shall be adjustable from the diffuser/register face without removing the core assembly.
 - b. All volume dampers shall be free from vibration, rattle and other noise when subject to the specified operating range or maximum airflows and indicated velocities. Noisy dampers shall be replaced by the Contractor at no expense to the Owner.
 - c. Provide fixed blade or pivot adjustable equalizing grids only on diffusers where specifically indicated or specified on the Drawings. Install equalizing grids, where required, with the blade direction perpendicular to the duct approach direction.
 - d. Provide galvanized steel square-to-round transition collars for all diffusers having square neck patterns which are indicated for connection with round ductwork.
 - e. Provide galvanized steel square-to-round transition collars for all diffusers having square neck patterns which are indicated for connection with round ductwork.
6. Quality Assurance and Testing
- a. All diffusers, registers and grilles shall be either factory and/or independently tested under controlled laboratory conditions in accordance with the applicable section of the Air Diffusion Council (ADC) Equipment Test Code

1062 and/or ISO Standard 3741. Testing shall substantiate the published catalogued engineering specifications and ratings. Devices which do not satisfactorily perform per their published ratings shall be subject to replacement by the Contractor at no expense to the Owner.

- b. Provide laboratory test results confirming published rating compliance with shop drawing submission.
- 7. Acceptable Manufacturers and Products
 - a. **Industrial Diffusers, Registers, Grilles and Bars**

Titus	Carnes	Krueger	E.H. Price
Tuttle & Bailey	Metal Aire	Anemostat	Nailor Industries
 - b. **Square and Round Diffusers - Adjustable Grid**

Carnes	Tuttle & Bailey	J & J	
Anemostat	Titus	Krueger	
Metal Aire	E.H. Price	Nailor Industries	
 - c. **Double Deflection Adjustable Registers**

Anemostat	Titus	Carnes	
Metal Aire	Krueger	Tuttle & Bailey	
J & J	E.H. Price	Nailor Industries	
 - d. **Fixed Curve Registers**

Anemostat	Titus	Carnes	
Metal Aire	Krueger	Tuttle & Bailey	
J & J	E.H.Price	Nailor Industries	
 - e. **Grilles**

Anemostat	Titus	Carnes	
Metal Aire	Krueger	Tuttle & Bailey	
J & J	E.H.Price	Nailor Industries	
 - f. **Adjustable linear slot diffusers**

Anemostat	Titus	Carnes	
Metal Aire	Krueger	Tuttle & Bailey	
J & J	E.H.Price	Nailor Industries	
 - g. **Do not use perforated plate diffusers on the project,**
- E. For devices installed in the fire rated ceiling assemblies and elsewhere specified on the drawings, provide fire rated ceiling diffusers or return registers with fire dampers. The rated air terminal shall be rated for use in a two hour rated structure. Provide link with a 212°F. fusible link. Access to the fire damper shall be provided through the diffuser. System shall meet NFPA 90A and UL fire damper requirements.
- F. Low leakage backdraft dampers. (Mark BDD).
 - 1. Dampers shall be of mill-finished extruded aluminum blades, frame and tie-bar linkage.
 - 2. Dampers shall be of low leakage weatherproof construction having neoprene blade seals and jamb seals suitable for either horizontal or vertical airflow operation up to 3500 fpm without blade deformation, sticking, jamming or vibration chatter.
 - 3. Provide with adjustable counterbalances (0.01 to 0.05 inches (W.G.) on all horizontally mounted dampers.
 - 4. Damper leakage shall be less than 12 cfm/sq. ft. at 0.5 inches (W.G.) pressure differential.
 - 5. Furnish Ruskin "CB" Series, Greenheck, Nailor Industries, or NCA Manufacturing.
- G. Air Turns: Double thickness streamline vanes with runners.
- H. Air Extractors for installation at branch duct take-offs shall be YOUNG REGULATOR CO, No. 890-B with positioning regulator for mounting on duct. Where positioning regulator is not accessible, air extractors shall be No. 890-A with coupling, extension rod and positioning regulator for installation on wall or ceiling.
- I. Access Panels: For all duct pressure classes shall be of same material as ducts in which they are installed, fabricated of two thicknesses of not less than 22 gage, with 1 inch thick

rigid glass fiber filler. Provide sheet metal frame, air tight gasket and two YOUNG REGULATOR COMPANY No. 1330 latches. Access panels shall not be secured by sheet metal screws or bolts. Only latch type fasteners are acceptable. Access door or panels shall be by Flexmaster, Nailor Industries, Cesco, or Keys.

- J. Joints: Joints for round, oval and rectangular high velocity and low pressure ductwork shall be in accordance with SMACNA joint details for the appropriate pressure class. Submit proposed method for joining ducts with fabrication procedures for review and approval.
- K. Damper identification
 - 1. Identify each damper with metal tag.
 - 2. Provide a schedule of dampers with the following data:
 - a. Tag number.
 - b. Owner's room where located and floor level .
 - c. Identify size, type and normal position (open, closed, modulating).
 - d. Identify equipment or branch served.
 - e. Identify location in area (ceiling, wall, chase, etc.).

Note: Smaller sized dampers which have obvious function or purpose, i.e., small duct balancing dampers.
 - 3. Damper tag numbers are to be noted in correct locations on Record Drawings, using plan symbols to identify type of damper being noted.
 - 4. Provide damper charts with operating and maintenance manuals.
 - 5. Dampers shall be identified with sequential numbering starting with number one (1).
 - a. Control dampers in supply air ductwork - SCD-1
 - b. Control dampers in return, exhaust or mixed air ductwork -RECD-1
 - c. Balance dampers in all ductwork - BD-1
 - d. Backdraft dampers in all ductwork - BDD-1

PART 3. EXECUTION

3.1. INSTALLATION

- A. Air duct connections to the ceiling mounted heat pumps shall be installed so there is a minimum of ten duct diameters of straight run of duct prior to connection to the unit unless specifically indicated otherwise on the drawings. Flexible duct shall not be used as part of this inlet straight run of duct.

END OF SECTION 15910

**SECTION 15950
AUTOMATIC CONTROL**

PART 1. GENERAL

1.1. AUTOMATIC CONTROLS

- A. Provide automatic control system in accordance with requirements specified here. Utilize programmable thermostats, programmable humidistats and other devices.
- B. Control items shall be Johnson Controls, Honeywell, Allerton by Engineered Controls, Reliable FM Controls, or Woodman Controls.

1.2. SECTION INCLUDES

- A. Automatic controls for heat pumps, heat pump loop circulators, de-humidifiers, humidifiers and energy recovery ventilators.
- B. The Control Subcontractor shall provide all necessary control wiring between controllers and operators, except for control wiring specified to be provided by the equipment manufacturer.
- C. Provide wall conduit, back boxes above ceiling, conduit from junction above ceiling routed out to communication cable tray or other specified mechanism for suspending control system wiring located in corridor.
- D. The Mechanical Contractor shall provide necessary blank off plates (safing) required to install damper that are smaller than duct size.
- E. The Mechanical Contractor shall install all automatic dampers and/or operators specified to be furnished by the Control Contractor in other sections.
- F. Assemble multiple section dampers with required interconnecting linkages and extend required number of shafts through duct for external mounting of damper motors for dampers specified to be furnished.
- G. The Mechanical Contractor shall provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation and affix and seal permanently in places only after stratification problem has been eliminated.
- H. The Mechanical Contractor shall provide access panel or other approved means of access through ducts for service to all new control equipment installed under this project.

1.3. SUBMITTALS

- A. Shop Drawings and Product Data:
 - 1. All Drawings shall be accompanied with a complete description of sequence of operation. Each control element mentioned in the sequence description shall be identified with same mark as shown on the control diagram.
 - 2. Controls System:
 - a. Submit the following in accordance with the requirements of Division 1.
 - 1) List of all control devices
 - 2) Components, materials and assembly details
 - 3) Capacity and performance data
 - 4) Installation procedures
 - 5) Complete electric wiring and control systems diagrams with written "Sequence of Operations" description, showing mechanical and electrical equipment furnished and electrical interlocks (where required) indicating terminal designation of equipment.
 - b. Upon completion of the Work of each system, submit spiral ring-board 8-1/2 x 11-inch clear plastic laminated diagrammatic layouts of the automatic control systems specified under this Section. Layouts shall show all control equipment, and the function of each item shall be indicated for the different seasons. Diagrams shall show, in addition to the automatic control system installation included herein, the major wiring included with the terminal heat pump units, pumping systems and miscellaneous fans, and any motor control center circuitry all of which interfaces with this system. Data shall be derived from and submitted with diagrams from the manufacturers of this equipment. All drawings shall be accompanied with a complete description of Sequence

of Operation. Each control element mentioned in the sequence description shall be identified with same mark as shown on the control diagrams. Drawings shall be presented in a manner to facilitate each visualization of the system operation.

- c. Submit with the above diagrams, full descriptions, documentation and operation instructions for all software provided with the control system. Include software test procedures with descriptions. All manuals dealing with any part of the system shall be included.

1.4. WARRANTY

- A. Components, parts and assemblies shall be warranted against defects in material and workmanship for a period of one year after acceptance. Expressed warranties are conditionally based on the requirement that the items covered within the warranty are used and maintained in accordance with the manufacturer's recommendations. Control system shall also be warranted to perform all functions expressed or implied in the Sequence of Operation. Failure of controls to perform these functions to the satisfaction of the Owner shall be corrected at no additional cost to the Owner. The warranty will not commence until the system is 100% up and running, all punch list items completed to the Owner's satisfaction, and Owner training completed, regardless of time the Owner has received benefit (substantial or otherwise) from the system during construction and installation.

1.5. DELIVERY, STORAGE, AND HANDLING

- A. All control devices shall be factory-cleaned, wrapped and packaged in boxes prior to shipping to construction site.
- B. Store control devices in original packaging in clean, dry spaces and protect them from weather, excessive humidity, temperature variations, dirt, dust, and other containments.
- C. Prior to installation, inspect control devices for damage.

1.6. QUALITY ASSURANCE

- A. Standard Products:
 - 1. Material and equipment shall be standard products of manufacturer regularly engaged in the manufacturing of such product, using similar materials, design and workmanship. The standard products shall have been in commercial or industrial use for two years prior to bid opening. The two year use shall include applications of similarly sized equipment and materials used under similar circumstances. The two year experience must be satisfactorily completed by a product which has been sold on the commercial market through advertisements, manufacturers' catalogs, or brochures.
 - 2. The equipment items shall be supported by a service organization.
- B. Nameplates and Tags
 - 1. Nameplates bearing legends as shown and tags bearing device unique identifiers as shown shall be engraved or stamped. Nameplates shall be permanently attached to HVAC control panel doors.
 - 2. For each field mounted piece of equipment, not in a finished area, a plastic or metal tag with equipment name and point identifier shall be attached.
- C. Verification of Dimensions. The Contractor shall become familiar with all details of the Work, shall verify all dimensions in the field, and shall advise the Owner's Representative of any discrepancy or conflicts before performing the control Work.

PART 2. PRODUCTS

2.1. MATERIALS

- A. Sensors and Input Hardware:
 - 1. Resistance Temperature Detectors (RTDs).
 - a. Provide RTD sensors with 1000 ohm, or higher, platinum element that are compatible with the digital controllers. Sensors shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 32°F. Temperature sensor stability error over five years shall not exceed 0.25°F. cumulative. Direct connection of RTDs to digital

controllers, without transmitters, is preferred provided controller supports direct connection of RTDs. When RTDs are connected directly to the controller, keep lead resistance error to 0.25°F. or less. Provide 3 wire sensing circuits to not exceed the 0.25°F. lead resistance error. Total error for a RTD circuit shall not exceed 0.5°F., which includes sensor error, lead resistance error or 4 to 20 milliampere transmitter error, and A/D conversion resolution error. Provide manufacturer documentation, and if required due to questionable point(s) data observed during testing, the Contractors engineering calculations which support the proposed RTD circuit will have a total error of 0.5°F. or less for the specified application.

- 1) Wiring:
 - a) Provide 18 gage twisted and shielded pair cable for direct connected RTDs.
 - b) Provide 18 gage twisted and shielded pair cable for RTDs using 4 to 20 milliampere transmitters.
- 2) Transmitters: Provide 4 to 20 milliampere transmitters for RTDs where:
 - a) Digital controllers do not Support direct connection of RTDs to controllers; and
 - b) Digital controllers do not meet temperature resolution requirement of 0.25°F.
2. Thermistors.
 - a. Precision thermistors may be used in temperature sensing applications below 200°F. Sensor accuracy over the application range shall be 0.36°F. or less between the range of 32°F. to 150°F. Sensor manufacturer shall utilize 100 percent screening to verify accuracy. Thermistors shall be pre-aged, and inherently stable. Stability error of the thermistor over five years shall not exceed 0.25°F. cumulative. Sensor element and leads shall be encapsulated. Bead thermistors are not allowed. A/D conversion resolution error shall be kept to 0.1°F. Total error for a thermistor circuit shall not exceed 0.5°F., which includes sensor error and digital controller A/D conversion resolution error. Provide thermistor and digital controller manufacturer documentation and the Contractor's engineering calculations which support the proposed thermistor input circuit will have a total error of 0.5°F. or less. Provide 18 gage twisted and shielded cable for thermistors.
3. Temperature Sensors / Programmable Thermostats.
 - a. General. Electronic temperature sensors shall be standard resistance type, platinum film element on ceramic chip, for all temperature ranges. All electronic temperature sensors shall be factory calibrated and of tamperproof construction. Temperature sensor accuracy shall be a minimum of $\pm 1\%$.
 - b. Room Type: Conceal element behind protective cover matched to the room interior. Read out shall be digital.
 - c. Duct Averaging Type: Continuous averaging RTDs for ductwork applications shall be 12 inches in length for each 4 square feet of ductwork cross-sectional area with a minimum length of 6 feet. Probe type duct sensors of 12 inches length minimum are acceptable in ducts 12 feet square and less.
 - d. Immersion Type: 3 inches total immersion for use with sensor wells, unless otherwise indicated.
 - e. Sensor Wells: Brass materials as indicated; provide thermal transmission material compatible with the immersion sensor. Provide heat-sensitive transfer agent between exterior sensor surface and interior well surface.
 - f. Outside Air Type: Provide element with sunshade to minimize solar effects. Mount element at least 3 inches from building outside wall. Sunshade shall

- not inhibit the flow of ambient air across the sensing element. Shade shall protect sensing element from direct solar incidence, snow, ice, and rain.
- g. Provide Honeywell T7350H1009 Communication thermostat control of the water to air heat pumps, DX cooling humidifiers and de-humidifiers.
 - 1) Provide 365 day programming.
 - 2) Two occupied and two unoccupied periods per day.
 - 3) Thermostat interface module connections from thermostat to PDA for advanced configuration programming and keyboarding.
 - 4) Individual heat and cool setpoints for both occupied and unoccupied modes.
 - 5) PID control.
 - 6) Recovery ramping control automatically optimizes equipment start times based on building load.
 - 7) Override capability to allow temporary set point changes.
 - 8) Keypad multi-level lockout in all modes.
 - 9) Remote sensor capability for temperature and humidity sensors.
 - 10) Auxiliary contact interfaces with economizer cycle or de-humidification output.
 - 11) LONworks network communication.
 - h. Provide remote wall temperature sensor Honeywell T7771A1005, 20kohm, NTC non-linear temperature wall module. Temperature sensor shall have push button setpoint adjustment with LED indication, occupied/unoccupied override with LED LONworks bus pods. The wall sensor shall be compatible with and acceptable for use with the T7350H1009 programmable thermostat.
 - i. Provide Honeywell TR21-A, 10 kohm, NTC, non-linear, wall modules for averaging only. Units shall be available with user selectable set points adjustments. Provide the TR21-A where indicated on the drawings for multiple zone sensing and averaging.
4. Transmitters.
- a. Transmitters shall have 4 to 20 ma output linearly scaled to the temperature, pressure, humidity, or flow range being sensed. Transmitter shall be matched to the sensor, factory calibrated, and sealed. Total error shall not exceed 0.1 percent of 20 milliampere (0.02 milliampere) at any point across the 4 to 20 ma span. Supply voltage shall be 24 volts ac or dc. Transmitters shall have noninteractive offset and span adjustments. For temperature sensing, transmitter stability shall not exceed 0.05°C. a year.
 - 1) Transmitter spans or ranges shall be the following and shall be suitable for the application:
 - a) Temperature:
 - (i) 50°F. span: Room, heat pump loop, cooling coil discharge air, return air sensors; range 35°F. to 85°F.
 - (ii) 110°F. span: Outside air, heating coil discharge air; range 0°F. to 110°F.
 - b) Pressure:
 - (i) -0.25 to 0.25 inches water differential range: static pressure control of rooms.
 - (ii) 0 to 5 inches water differential range: Duct static pressure or filter pressure drop.
 - (iii) 0 to 60 PSI differential: Pump differential pressure (HVAC).
 - (iv) 10-200 psi steam pressures.
 - c) Relative Humidity:
 - (i) 0 to 100 percent relative humidity range
5. Relative Humidity Sensor Controllers.
- a. Provide Honeywell Transmitter H7635A1001, wall mount without temperature for use with the T7350 H series programmable thermostat. Ceramic

technology humidity sensors shall not be affected by condensation. Transmitter shall provide temperature compensated output with negligible hysteresis. Provide zero and span trimmers increment/decrement recalibration. Provide capability of either 4-20 mA, 0-10 Vdc or 0-5Vdc control output. NIST traceable 2%, 3% and 5% calibration. Refer to drawings for humidity transmitter locations.

6. Pressure Transmitters.
 - a. Provide integral pressure transducer and transmitter. Output of pressure instrument shall be a 4 to 20 milliampere signal proportional to the pressure span. Span shall be as specified. Accuracy shall be 1.0 percent. Linearity shall be 0.1 percent. Supply voltage shall be 24 vdc. Transmitter shall meet specified requirements.
- B. Output Hardware:
1. Output Switches: Control relays shall be double pole, double throw (DPDT), UL listed, with contacts rated to the application, and enclosed in a dustproof enclosure. Equip with a light indicator which is lit when coil is energized and is off when coil is not energized. Relays shall be socket type, plug into a fixed base, and be replaceable without need of tools or removing wiring.
 2. Refer to division 16 specifications for special environmental requirements (i.e. wet location, flammable, dust) for output hardware.
 3. Automatic Control Dampers
 - a. Dampers indicated to be replaced shall conform to SMACNA-HVAC Duct Construction Standards (latest edition).
 - b. A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sized dampers shall be made from a combination of sections.
 - c. Standard control dampers, not in direct contact with outdoor ambient temperature air, shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. Blades shall be provided with compressible seals at points of contact. The channel frames of the dampers shall be provided with jamb seals to minimize air leakage. Dampers shall not leak in excess of 20 cfm per square foot at 4 inches water gage static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40°F. to 200°F. Dampers shall be rated at not less than 2000 fpm air velocity. All blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section will not be located directly in the air stream. Damper axles shall be 0.5 inch (minimum) plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 0.04 inch water gage at 1000 fpm in the wide-open position. Frames shall not be less than 2 inches in width. Dampers shall be tested in accordance with AMCA 500.
 - d. Operating links external to dampers (such as crank arms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers) shall withstand a load equal to twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crank arms shall control the open and closed position of dampers.
 - e. For all outside air intakes, exhaust air and similar plenum control damper requirements, where dampers are in direct contact with outdoor ambient temperature air, including those integral or external to air-handlers, provide operable opposed-blade or parallel blade, anodized aluminum (insulated) airfoil sections having a minimum of 94 percent free area and a maximum static pressure drop of 0.25 inch (W.G.). Damper jamb (and hollow airfoil blade) sections to be filled with polyurethane or styrofoam insulation and

shall incorporate a thermal break on all blade sections. Damper in closed position to have a thermal conductance of not greater than 0.10 Btuh/square foot - degrees F. Damper blades to be equipped with full width continuous wing-type vinyl or neoprene rubber gaskets allowing not more than 6.25 cubic feet per minute (CFM) per square foot leakage under 4 inches (W.G.) static pressure differential. Caulk and flash frame as required to fit opening. Provide Ruskin "CD Series Insulated Airfoils," or Design Professional approved equivalent by the Control Contractor. Dampers shall be furnished complete with operator. Damper shall operate as shown on the Contract Drawings or as specified in the Sequence of Operations. Verify all dimensions (on site) prior to ordering equipment.

4. Actuators: Provide electric motor operated type with spring return so that, in the event of power failure, actuators shall fail safe in either the normally open or normally closed position as specified on the drawings. Actuators shall be fully modulating and be controlled by either a 0-10VDC or 4 to 20mA control signal. Pulsing operators are not acceptable. Actuators shall be quiet operating and function properly within the range of 85 to 110 percent of the motive power. Provide a minimum of one actuator for each damper. Do not provide two position open/closed operators for any of the specified modulating operators. It is also the design intent that the damper/operator combination spring return so dampers fail open on power failure. Provide actuators that can easily be field adjusted to be either spring opening or spring closing.

C. Electrical Power and Distribution:

1. Power input from building electrical system shall be 120 volts, 60 Hz, two-pole, three wire with ground. Power from the building electrical system to the DDC panels shall be provided by the Electrical Contractor. The Control Contractor shall be responsible for all power to individual control devices.
2. Provide control voltage transformers as needed throughout the control system which shall conform to UL 506. Power digital controllers on the highest level LAN from dedicated circuit breakers. Transformers for digital controllers serving terminal equipment on lower level LANs shall be fed from the fan motor leads or fed from the nearest distribution panel board, motor control center, or panelboard, using circuits provided for the purpose or shall be powered from the control power. Provide surge suppressors and transient protection for the control devices powered externally from the control system. Provide a circuit breaker on the secondary side of the transformer.
3. Surge and transient protection consist of devices installed externally to digital controllers.
4. Surge suppressors external to digital controller, shall be installed on all incoming AC power. Surge suppressor shall be rated by UL 1449, and have clamping voltage ratings below the following levels:
 - a. Normal Mode (Line to Neutral): 350 Volts
 - b. Common Mode (Line to Ground): 350 Volts
5. Controllers shall have sensor and control wiring surge protection with optical isolation, metal oxide varistors (MOV), or silicon avalanche devices. Fuses are not permitted for surge protection.
6. Provide complete electric wiring for control apparatus, including wiring to transformer primaries. Control circuit conductors which run in the same conduit as power circuit conductors shall have the same insulation level as power circuit conductors. Circuits operating at more than 100 Volts shall be in accordance with the applicable NEC requirements. Circuits operating at 100 Volts or less shall be defined as low voltage and shall be run in rigid or flexible conduit, metallic tubing, metal raceways, wire trays, or suspended above ceilings with "J" or "bridal" hooks in accordance with Division 16 requirements for low voltage cable. Use multi-conductor cable for concealed accessible locations only. Provide circuit and wiring protection as required by NFPA 70. Control wiring in HVAC ductwork

shall be in conduit or metallic tubing. Control wiring in equipment rooms and in rooms without ceilings shall be in EMT. There shall be no exposed wiring outside of conduit in "public" spaces. Protect exposed wiring from abuse and damage. All control wiring located in ceiling plenums shall be in EMT or shall be rated for use in plenums if not installed in EMT. The Control Contractor shall provide new "J" or "bridal" hooks for supporting new control wiring located above ceilings. The Contractor shall not use any other system "J" or "bridal hooks" to support any control wiring. The Contractor shall not "drape" any control wiring through or from structural components.

- a. AC Control Wiring.
 - 1) Control wiring for 24 V circuits shall be insulated copper 18 AWG minimum and shall be rated for 300 VAC service.
 - 2) Wiring for 120 V ac control service shall be 14 AWG minimum and shall be rated for 600 V ac service.
- b. Digital Signal Voltage Wiring: Wiring shall be shielded (2 conductor solid copper) cable. Shielding shall be aluminum/polyester foil or approved equal suitable for high frequency electrical noise shielding. For lines longer than 300 feet, provide #18 AWG shielded, twisted wire pair conductors. For lines with lengths under 300 feet, furnish #22 AWG or #18 AWG shielded, twisted wire pair conductors (Belden, AT&T or Manhattan).
- c. Analog Signal Wiring: Analog signal wiring for analog inputs and analog outputs shall be 18 AWG single or multiple twisted pair. Each pair greater than one shall be 100 percent shielded, and have 20 AWG drain wire. Exception is directly connected RTD wiring which shall be 18 AWG minimum twisted pair, 100 percent shielded, and with 20 AWG drain wire. Each wire shall have insulation rated to 300 V ac. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned copper cable drain wire, and overall cable insulation rated to 300 VAC.
- D. Components for outside locations: Any control components located in the outside air shall be enclosed in weatherproof enclosures and shall be suitable for operation in this environment.

PART 3. EXECUTION

3.1. INSTALLATION

- A. Perform installation under supervision of competent technicians regularly employed in the installation of control system. Provide components for a complete and operational control system.
- B. Digital Controllers / Programmable Thermostats:
 - 1. Do not divide control of a single mechanical system such as an air conditioning unit, or terminal equipment between two or more controllers. A single controller shall manage control functions for a single mechanical system.
- C. Provide temperature sensors in locations to sense the appropriate condition. Provide sensor where they are easy to access and service without special tools. Calibrate sensors to accuracy specified. In no case will sensors designed for one application be installed for another application such as replacing a duct sensor with a room sensor.

3.2. ADJUSTMENTS

- A. Calibrate instrumentation and controls and verify the specified accuracy using test equipment with a test equipment accuracy. Adjust controls and equipment to maintain conditions indicated, to perform functions indicated, and to operate in the sequence specified.

3.3. FIELD QUALITY CONTROL

- A. General:
 - 1. Demonstrate compliance of the heating, ventilating, and air conditioning control system with the contract documents. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Testing will include the field tests and the performance verification tests. Field tests shall demonstrate proper calibration of input and output devices, and the

operation of specific equipment. Performance verification test shall ensure proper execution of the sequence of operation and proper tuning of control loops.

2. Tests are subject to oversight and approval by the Design Professional. The testing may not be performed during scheduled seasonal off-periods of heating and cooling systems if that is deemed acceptable by the Design Professional.

B. Test Reporting for Field Testing and Performance Verification Tests:

1. Document all tests with detailed test results. Explain in detail the nature of each failure and corrective action taken.
2. During and after completion of the Field Tests, and again after the Performance Verification Tests, identify, determine causes, replace, repair or calibrate equipment that fails to meet the specification, and deliver a written report to the Design Professional.
3. Provide a written report containing test documentation after the Field Tests and again after the Performance Verification Tests. Convene a test review meeting at the job site to present the results to the Design Professional and Owner's Representative. As part of this test review meeting, demonstrate by performing all portions of the field tests or performance verification test that each failure has been corrected. Based on the report and test review meeting, the Design Professional will determine either the restart point or successful completion of testing. Do not commence retesting until after receipt of written notification by the Design Professional. At the conclusion of retesting, assessment will be repeated.

C. Contractor's Field Testing. Calibrate field equipment and verify equipment and system operation before placing the system on-line. Field testing shall include the following tests:

1. System Inspection.
 - a. Observe the HVAC system in its shutdown condition. Check dampers and valves for proper normal positions. Document each position for the test report.
2. Calibration Accuracy and Operation of Inputs Test.
 - a. Check for proper calibration and operation of each input instrument. For each sensor (temperature), record the reading at the sensor, and using traceable test equipment, and record the reading at the digital controller. Document each reading for the test report.
3. Operation of Outputs Test.
 - a. Check the operation of each output to verify correct operation. Command digital outputs on and off. Command analog outputs to minimum range, such as 4 mA, and maximum range, such as 20 mA, measure and record commanded and actual output values. Document each command and result for the test report.
4. Actuator Range Adjustment Test.
 - a. With the digital controller, apply a control signal to each actuator and verify that the actuator operates properly from its normal position to full range of stroke position. Record actual spring ranges and normal positions for all modulating control valves and dampers. Include documentation in the test report.
5. Digital Controller Startup and Memory Test
 - a. Demonstrate that programming is not lost after a power failure, and digital controllers automatically resume proper control after a (simulated) power failure.
6. Surge Protection.
 - a. Show that surge protection, meeting the requirements of this specification, has been installed on incoming power to the digital controllers and on system-interconnected communications lines.

3.4. SEQUENCE OF OPERATION

- A. General: Sequence of Operations for all HVAC equipment shall be as indicated on the drawings and in the technical specifications.

END OF SECTION 15950

SECTION 15990
TESTING, ADJUSTING, AND BALANCING

PART 1. GENERAL**1.1. SECTION INCLUDES**

- A. HVAC systems air and water balancing for equipment installed under this contract.
- B. One balance is required.
- C. Balancing work shall be included under the Division 15 Work for the project.
- D. Bidders shall submit bids for this sections work from balancing contractors that have been specified for this work.
- E. Include balancing of geothermal loop field as specified in Section 15031.
- F. Balancing shall be done in concert with the Section 15950 control system set up and set up on the heat pump system controls specified in Section 15782.
- G. Balancing shall include sound measurements.

1.2. SUBMITTALS

- A. Submit the credentials of the balancing agency to the Design Professional for review.
- B. Submit a finished balancing report within 20 days after completion of the system balancing. Submit a list of system problems (if any discovered) within one week of completion of the field balancing. Provide interim balancing reports after each phase of balancing.
- C. Submit verification of equipment calibration.
- D. Submit "draft" reports from initial balancing work to assist in control system set up and troubleshooting.

1.3. ASSOCIATED WORK

- A. Testing, adjustment and balancing of air systems.
- B. Testing, adjustment and balancing of hydronic systems.
- C. Measurement of final operating condition of HVAC systems.

1.4. STANDARDS AND QUALIFICATIONS

- A. AABC - National Standards for Field Measurement and Instrumentation, Total System Balance.
- B. ASHRAE - Systems Handbook: Chapter 37, Testing, Adjusting and Balancing.
- C. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems. The Balancing Contractor shall be AABC, NEBB or SMARTA certified. The Contractor shall submit these certifications with the bid, and also as part of the submittal process for the project.
- D. The bidders shall submit bids for the Testing, Adjusting and Balancing from a one of the Balancing Contractor's listed below.
 - 1. System Management and Balancing
925 SE Olson Dr.
Waukee, IA 50263
515.987.2825 (voice)
515.987.5036 (fax)
 - 2. Precision Test and Balance
14241 Elmcrest Court
Clive, IA 50325
515.288.2332 (voice)
515.222.0613 (fax)
 - 3. River Place Technologies, LLC
1203 Jersey Ridge Road
Suite 108
Davenport, IA 52803
563.323.0800 (voice)
563.323.0803 (fax)

1.5. SEQUENCING AND SCHEDULING

- A. Sequence work to commence after completion of systems and schedule completion of work before substantial completion of the project.
- B. Sequence and schedule the balancing work to coincide with the Control System Subcontractor's system set up.
- C. Balancing Contractor shall formally meet with the Design Professional prior to beginning the balancing work on site. The Balancer shall present and explain the balancing procedure approach, understanding of the variable flow systems, and the control systems. Balancer shall also indicate pre-requisites (i.e. systems completed and ready to adjust for balancing).

1.6. WARRANTY

- A. Testing Agency shall include an extended warranty of 90 days, after completion of test and balance Work, during which time the Design Professional at his discretion may request a recheck, or resetting of any outlet, supply air fan, return/exhaust fan or pump as listed in test report. The Testing Agency shall provide technicians to assist the Design Professional in making any tests he may require during this period of time.
- B. Sequence and schedule the balancing work to coincide with the Control System Subcontractor's system setup.

PART 2. PRODUCTS

2.1. NOT USED

PART 3. EXECUTION

3.1. SYSTEM BALANCING

- A. All costs associated with system balancing and testing shall be included within the Division 15 Work Category.
- B. The services of an AABC, NEBB, SMARTA Certified Balancing Contractor, or other recognized accredited agency shall be used to provide labor, services and test equipment required to adjust and balance heating, ventilating, air conditioning and exhaust systems of mechanical systems as specified.
- C. Personnel involved in the execution of the work under the balancing portion of the work shall be experienced and trained in the total balancing of mechanical systems, as well as being regular employees of the balancing Agency.
- D. The Division 15 Contractor shall cooperate with the balancing agency by:
 - 1. Completing all construction including integrity testing prior to the start of balancing.
 - 2. Including balancing dampers and adding dampers requested by the balancing Agency.
 - 3. Putting complete system into operation during duration of balancing period.
 - 4. Providing Record Drawings and advise of changes made to the system during construction.
 - 5. Providing labor and equipment and cost of performing corrections such as dampers, belts and pulley changes, valves, etc. as required without delay.
 - 6. Providing complete submittal information for mechanical equipment complete with pertinent engineering information.
- E. The system balancing test shall incorporate the following:
 - 1. Adjust and balance the complete mechanical system as hereinafter specified.
 - 2. Record test data for the air and hydronic systems. All data pertaining to a particular system, including supply, return and exhaust air, shall be submitted in a complete report on that system. Submit one copy each to the General Contractor, Design Professional, the Owner, and the Record Documents file. Provide interim report drafts on preliminary balances made to assist in troubleshooting.
- F. Test equipment shall be furnished by the balancing agency and will remain the property of the balancing agency. Instruments shall have been calibrated recently.

3.2. AIR TEST AND BALANCING PROCEDURE

- A. Measure supply air volumes by means of the duct traverse method. Seal duct access holes with rubber plugs. Duct tape is not an acceptable method of sealing.
 - B. Adjust balancing dampers for required branch duct air quantities to within $\pm 5\%$ of the individual branch air flow requirements.
 - C. Adjust grilles, registers and diffusers to within ± 5 cfm of individual requirements specified, and also adjust to minimize draft in all areas.
 - D. Changes that are required for the final balancing results as determined by the balancing agency shall be provided for by the respective contractors who supply and install such equipment under their contractual obligations. Such changes may encompass, but are not necessarily restricted to, changing the dampers or adding dampers and access panels.
 - E. Utilize fan motor transformer taps and internal unit speed control settings to set up heat pump at design flow conditions.
- 3.3. SPECIFIC HYDRONIC BALANCING PROCEDURES
- A. Terminal balancing:
 - 1. Terminals shall be checked for flow prior to using either of the two balancing procedures.
 - 2. Acceptable balancing procedures #1 if adjustments must be made:
 - a. All of the terminal balancing valves shall be preset to a value calculated to provide equal pressure loss throughout all terminal circuits (terminals, control valves, strainers, valves, and piping) at balanced flow conditions.
 - b. The terminal flow rates shall then be tested, and adjusted up or down to provide a plus/minus variation of 10% or less of equivalent proportional flow (EP).
 - 3. Acceptable balancing procedure #2 is the so-called "sequential" balancing method of procedure #1.
 - 4. Acceptable balancing procedure #3:
 - a. If the system pump has a very flat head characteristic such that the maximum to minimum pressure drop across any terminal circuit produces a flow rate change of less than 20% of design flow, the system may be balanced under normal operating conditions.
 - b. With the total system flow rate, measured at the pump, at near normal design flow, each terminal shall be balanced at maximum flow, (terminal control valve wide open), and all other terminals operating under controlled flow conditions (control valves modulating).
 - 5. The following data shall be recorded and reported for all terminals if balancing procedure #1 is used.
 - a. pre-set balancing valve setting.
 - b. design flow rate (GPM).
 - c. initial flow rate (GPM).
 - d. final balancing valve setting.
 - e. final flow rate (GPM).
 - f. final percent of EP flow rate.
 - 6. The following data shall be recorded and reported for all terminals if balancing procedure #2 is used:
 - a. design flow rate (GPM).
 - b. initial flow rate (GPM).
 - c. EP flow rate (GPM).
 - d. initial percent of EP flow rate (GPM).
 - e. final actual flow rate (GPM).
 - f. final EP flow rate (GPM).
 - g. final percent of EP flow rate.
 - 7. The following data shall be recorded and reported for all terminals if balancing procedure #3 is used:

- a. terminal design flow rate (GPM).
 - b. system design flow rate (GPM).
 - c. system actual flow rate (GPM).
 - d. terminal maximum flow rate (GPM).
 - e. terminal initial actual flow rate (GPM).
 - f. terminal final actual flow rate (GPM).
8. If the terminal initial flow rate is more than 20% less than the terminal maximum flow rate, the terminal circuit pressure drops shall be measured to determine the cause of the excess pressure drop.
 9. The balancing contractor is advised that piping distribution systems are the header circular loop system, not the radial feed parallel or reverse return system design.
- B. Miscellaneous Hydronic Balancing Items:
1. For systems with modulating three-way valves it is required that an additional flow measurement and adjustment is made; the flow rate in the terminal by-pass mode shall be equal to, or less than the flow rate when directed through the terminal. This adjustment should be made when the three-way valve is in the position which allows the greatest flow.
 2. The TAB agency shall use balancing locks (memory stops wherever these devices are furnished). For valves with numbered dials, the setting shall be recorded and reported. Valves lacking memory stops or numbered dials shall have their position marked with a felt-tip pen. For valves with notched positions, the number of notches from either the open or closed position to the set position shall be counted, recorded, and reported.
 3. Flow rates and pressure drops through all applicable heating and cooling coils shall be recorded and reported.
 4. The hydronic systems TAB report shall include floor plans as described under Air Balancing part of this specification. The tabulation sheets shall include room numbers for the rooms served by the terminals, the location of the terminals by room number and for terminals serving more than one space or room.
- 3.4. VARIABLE FLOW SYSTEM SETUP FOR TESTING AND BALANCING
- A. Variable water flow systems serve the areas where indicated on the drawings.
 - B. The heat pump loop system.
 - C. Capacities indicated on the drawings for heat recovery unit, and heat pumps, air conditioning units and pumps are maximum flow rates for the components which include capacity for future loads. It is recognized that when the building systems are commissioned that all components will not be running at the maximum capacities scheduled.
 - D. The operating conditions shall be simulated as follows after individual devices are set up on an individual basis:
 1. Areas served by variable flow for systems: The thermostat for each zone shall be set to simulate a call for full cooling or other controls set up for full ventilation. Supply, return and exhaust registers shall be checked and set to deliver the maximum flow rates indicated on the drawings. After the individual terminal device setup, the zone thermostat shall be reset to call for full heating. The reheat coil or other terminal unit shall be balanced for the specified flow scheduled on the drawings.
 2. Overall air system setup - After individual rooms have been balanced, the operation of the overall system shall be verified by placing 50% of the zones in a simulated cooling mode (full flow) and 50% of the zones in the heating mode (minimum flow). Air system readings as specified before shall be taken and any necessary setpoint adjustments shall be made. Pressure controllers and sensors and air system interlocks shall be set and verified during this setup.
 3. Supply, returns and exhaust duct system pressure setpoints.

- a. The pressure control setpoints and bypass valve used to control the water variable flow rates shall be set up to maintain the required flow rates and pressure relationships specified in the control sequences.

3.5. TESTING PROCEDURE FOR SOUND LEVELS

- A. Using recently calibrated instruments, conduct sound level tests in selected areas of the building. Measure sound level readings in decibels in each active band, and on the "A" and "C" scales of the General Radio Company sound level meter, or sound level meter that meets the current American Standard (Z24 3) based on the acoustic reference power of DB/-RE 10. 13W. Readings shall set forth the total random sound level of the selected rooms or areas with the system in operation, as compared to total background sound level with the system not in operation. The system increase over the background level shall be recorded in decibels on the "A" and "C" scales, and in each octave band.
 1. Identify each outlet by room name, room number, and air outlet number.
 2. Measure sound levels in decibels at each diffuser, grille or register in listed areas in each of the 8 octave bands. Measure sound levels approximately five feet above the floor on a line directly below the center of the diffuser, etc., on the "A" and "C" scales of a general radio company sound level meter, and in each octave band.
 3. Tabulate data for the following rooms with heat pump(s) and respective air-handling equipment in operation.
 - a. Museum
 - b. Meeting rooms.
 - c. Mechanical equipment rooms
 - d. Areas immediately adjacent to mechanical equipment rooms.
 4. Measure the sound level contribution by the heat pump loop circulating pump.

3.6. BALANCING DATA

- A. System report shall include the following information:
 1. Heat Pumps
 - a. Manufacturer, size and capacity.
 - b. Fan CFM (Design and Final Operating)
 - c. Fan Reference number, name or letter
 2. System External to air handling unit - Test Data
 - a. Grille, Diffuser or Hood reference number and manufacturer
 - b. Location (room number and name)
 - c. Design velocity and CFM or GPM
 - d. Flow Factor
 - e. Final condition of balance
- B. Interface with control installer of Section 15950:
 1. Provide input to control installer so thermostats, valves, dampers, pressure controllers, variable speed drives and other control devices can be adjusted to provide design conditions.
 2. Evaluate control system for its effect on the system balancing and advise the control installer, Contractor and Design Professional of all changes necessary to aid in system balancing.
- C. The testing and balancing agency shall use SMACNA testing and balancing forms for the balancing report.

3.7. GEOTHERMAL LOOP FIELD HEADER SYSTEM

- A. Refer to Section 15031 for geothermal loop field balancing and testing requirements.

END OF SECTION 15990

**SECTION 16010
ELECTRICAL GENERAL PROVISIONS**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Provide all labor and materials and all equipment to make complete operating electrical systems. Place all equipment in initial operation, make all initial tests to ensure compliance with specifications and their intent, obtain approval in writing from all governing bodies having jurisdiction to ensure compliance with all laws and ordinances in effect.
- B. Plans are to be considered as schematic, written dimensions shall govern, dimensioned architectural plans shall take precedence over undimensioned electrical plans, any questions as to exact location of equipment shall be verified with the Engineer. All work must be coordinated with all other trades.
- C. Where noted on the drawings or where indicated in other sections of the specifications, this Division shall install equipment furnished by others and shall make required service connections. Verify with the supplier of the equipment the requirements for the installation.

1.2. MEASUREMENTS

- A. All measurements must be verified from actual observation at the building. This Contractor shall be responsible for all his work fitting in place in approved, satisfactory, and workman like manner in every particular.

1.3. DRAWINGS AND SPECIFICATIONS

- A. Drawings for the work are diagrammatic, intended to convey the scope of the work and to indicate the general arrangement and location of the work. Because of the scale of the drawings, certain basic items such as conduit fittings, sleeves and access panels may not be indicated. Where such items are required by code or by other specifications sections or where required for the proper installation of the work, such items shall be included. Inclusion of such items shall not be a basis for any contract amount or duration changes.

1.4. LAWS, PERMITS AND REGULATIONS

- A. Contractor shall obtain and pay for all licenses and permits and pay all fees and/or charges for meters electric services and associated devices, pay all charges for connection to outside services. The Contractor shall comply with all laws, ordinances, regulations, and code requirements applicable to his work.
- B. Work shall comply with the latest issues of the National Electrical Code and State of Iowa Building Code, and local codes.
- C. Secure inspections required by the Authorities with jurisdiction over the site.
- D. Where applications are required for procuring of services to the building, prepare and file such application with the Utility Company. The Division 16 Contractor will pay all Utility Company fees. This section shall furnish information required for the application in the form required by the Utility Company.

1.5. TESTS AND INSPECTIONS

- A. Final settlement will not be made with the Contractor until all systems have been thoroughly checked and found in good operating condition. All materials and workmanship shall be subject to inspection, examination and test by the Engineer at any and all times. The Engineer shall have right to reject any defective material or workmanship and require its correction without cost to the Owner.
- B. Systems shall be tested by the Contractor and placed in proper working order prior to demonstrating systems to the Engineer.
- C. Perform such tests as required by authorities having jurisdiction over the site.
- D. Prior to acceptance of the work, the Contractor shall demonstrate to the Engineer, all features and functions of all system. Each system shall be demonstrated.
- E. The demonstrations shall consist of not less than the following:
 - 1. Point out the actual location of each component of a system and demonstrate its function and its relationship to other components within the system.

2. Demonstrate the electrical systems by actual "start-stop" operation showing how to work controls, how to reset protective devices, how to replace fuses, and what to do in emergency.
 3. Demonstrate communication, signal, alarm and detection systems by point to point actual operation of the systems and show how to reset signal, alarm and detection devices.
- F. Systems to be demonstrated shall include the following:
1. Service and power distribution systems
 2. Lighting and lighting controls systems.
 3. Motor and equipment control.
 4. Fire alarm system
 5. Voice/Data System
- G. Contractor shall furnish the necessary trained personnel to perform the demonstrations and instructions, and shall arrange to have the manufacturer's representatives present to assist with the demonstrations.
- H. Contractor shall arrange with the Engineer the dates and times for performing the demonstrations, at least two weeks in advance.
- 1.6. COOPERATION AND PROGRESS**
- A. It shall be the Contractor's responsibility to schedule and coordinate his work to progress the work expeditiously, and to avoid unnecessary delays.
 - B. The Contractor shall examine fully the Drawings and the Specifications for other Subcontractors of the other trades, and shall coordinate the installation of his work with the work of the other Subcontractors. Contractor shall consult and cooperate with other Subcontractors for determining space requirements and for determining that adequate clearance is allowed with respect to his equipment, other equipment and the building. The Owner reserves the right to determine space priority for the Contractors in the event of interference between piping, conduit, ducts and equipment of the various Subcontractors.
 - C. Installation of new services distribution shall be scheduled and coordinated to minimize disruption.
 - D. Coordination of utilities shall demonstrate the components that will be installed and how the service area is to be maintained to all components.
- 1.7. PROTECTION OF WORK**
- A. Contractor shall protect his work from damage or injury by keeping all conduits, outlets, ducts, etc., plugged, capped, or otherwise protected. Any such injury or damage shall be replaced or repaired without cost to the Owner. All pieces of equipment shall be suitably protected, and upon completion of project shall be equal to new condition.
- 1.8. OPERATING MANUALS, INSTRUCTIONS**
- A. Upon completion of the project and before acceptance by the Engineer, the Contractor shall turn over to the Engineer complete Operating and Maintenance Manuals, Operating Instructions, etc., for all equipment furnished by him. Furnish complete operating instructions to the designated representative of the Engineer for each piece of equipment.
 - B. Prior to completion of work and before acceptance by the Engineer of substantial completion certification, the Contractor as it applies to his work, shall submit a rough draft of complete Operating and Maintenance Manuals that are properly indexed to identify all submittals.
- 1.9. EQUIPMENT BY OTHERS**
- A. The Contractor shall provide wiring for equipment furnished by others. Consult other sections of specifications and drawings for exact determination and requirements.
 - B. Whether starters furnished under this Contract or not, the Contractor is responsible for checking overload relays on all starters and equipment to ensure proper motor protection. Any discrepancies to be reported in writing to Contractor furnishing equipment. It is imperative that the Contractor inspect other sections of specifications to determine extent of electrical work required of him in making connections to equipment furnished and installed by others.

- C. In general, the Contractor shall extend wiring to the disconnect switch, furnish the disconnect switch, extend wiring to the starters, control panel, or other device furnished with the equipment. This Contractor shall make connections to pushbutton stations or other pilot devices at the equipment. Final motor or equipment connections shall be flexible conduit, not more than three feet long. The Contractor must confer with contractor furnishing equipment to ensure proper roughing-in without conflict.
 - D. All work shall be done in a neat and workmanlike manner and present a neat appearance when completed.
- 1.10. WALL PENETRATIONS AND FIRE PROOFING
- A. All penetrations of corridor walls and rated fire and smoke walls, floors, and ceilings shall be by conduit. Conduit penetrations shall be surrounded with fire safing material as by 3M #CP25 or equivalent. All penetrations, sleeves, and conduits including open ended conduits not terminated in junction boxes shall be filled with fire safing material as manufactured by 3M #CP25 or equivalent. In all instances of rated wall penetrations, the integrity of the fire rating must be maintained in accordance with the Uniform Building Code and NFPA.
 - B. All conduit passing through rated walls, ceilings, and floors shall conform to UL standards and be installed as shown in details.
- 1.11. IDENTIFICATION
- A. Provide identification for wiring systems and equipment.
 - B. Panelboards shall have typewritten circuit directories installed inside the doors under transparent plastic cover. Circuit directories shall identify, for each circuit, the type of load (lighting, outlets, equipment item) and room numbers of areas served.
- 1.12. CONCRETE WORK
- A. Division 16 shall provide concrete pads and bases for all electrical equipment. Unless otherwise noted concrete bases and pads shall have 4000 psi comprehensive strength after a 28 day cure. Reinforcement shall be as detailed. Provide equipment anchor bolts and coordinate their proper installation and accurate location. Refer also to the specification section for cast-in-place concrete. Where the provisions of that section are more stringent than those called for in this Section, the cast-in-place concrete section shall govern.
- 1.13. EXCAVATING, TRENCHING AND BACKFILLING
- A. Complete excavating necessary for underground wiring, conduit and ductbanks. Backfill trenches and excavations after work has been inspected. Work shall be in accordance with the requirements as follows, and the requirements of DIVISION 15. Care shall be taken in excavating, that walls and footings and adjacent load bearing soils are not disturbed in any way, except where lines must cross under a wall footing. Where a line must pass under a footing, the crossing shall be made by the smallest possible trench to accommodate the conduit. Excavation shall be kept free from water by pumping, if necessary. No greater length of trench shall be left open, in advance of conduit laying, than that which is authorized or directed by the Owner's Representative.
 - B. Roots shall be removed to a level 18 inches below finished grades and deeper as required for duct runs, manholes, and light pole bases. No roots shall be allowed to remain under the work.
 - C. Backfill about the structures shall be placed, when practicable, as the work of construction progresses. Backfilling on or against concrete work shall be done only when directed. Backfilling of duct lines shall progress as rapidly as the testing and acceptance of the finished sections of the work will permit and shall be carried to a crown approximately 6 inches above the existing grades. In backfilling around duct lines, fill sand shall be compacted firmly around and to a depth of not less than 6 inches over the top of the duct. Fill, backfill and rough grading shall be compacted thoroughly in layers, and shall be brought up to within 6 inches of finished grades. The final layer of backfill, from 6 inches below to 6 inches above grade, shall be done using good quality topsoil. Fill and backfill shall be clean and free from vegetable matter and refuse.
- 1.14. MODEL NUMBERS

- A. Model numbers are used in some instances to help define the overall characteristics required of a specific component, however, it is recognized that model numbers change from time to time or that the model numbers listed may be incorrect. The Contractor shall provide the components that satisfy the performance requirements specified, rather than providing units meeting the model number requirements in the event there is a discrepancy.
 - B. The bidder and Contractors shall not rely solely on the model numbers for selecting the appropriate components to be furnished.
 - C. It is the bidder's sole responsibility to call to the attention of the Engineer any discrepancies between the performance requirements specified and any model number used during the bidding period prior to issue of the last addendum. If no such notification is made it will be assumed that no such discrepancies exist.
- 1.15. WARRANTY/GUARANTEE:
- A. Upon written acceptance of the Work, the Contractor shall warrant/guarantee, and be responsible for, proper operation of the Work for a period of one calendar year following the date of Substantial Project Completion, or the respective date of acceptance of each item of equipment, system, or area of the Work. The Contractor shall be held liable for the Work during the guarantee period, and shall make good any faults or imperfections that may arise due to defects or omissions in materials or workmanship.
- 1.16. SUBMITTALS
- A. Coordinated shop drawings shall be provided on all equipment specified in Division 16 and shall be in accordance with the applicable sections and general provisions of this specification. Additionally, all shop drawings submitted pertaining to major equipment items shall include the particular item(s) intended for installation indicating sufficient information to ensure compatibility with physical constraints, manufacturer required maintenance and code clearances, and indication of non-interference with work installed by other trades and other work installed by this trade. Submittals not in accordance with the above noted conditions will be returned to the Contractor without action. Any claims arising from delay in construction scheduling arising from submission of non-conforming shop drawings will not be honored.
 - B. Substitute Items:
 - 1. Following contract award, modified structural, architectural, mechanical, and electrical work or redesign required as a result of the Contractor implementing an approved Alternate, or providing substitute or "approved equal" materials and equipment shall be at no additional cost to the Owner. Said costs shall be borne in their entirety by the Contractor, unless specifically stated and included as such in the Contractor's bid submission under Substitute Items bid requirements as outlined in Division 1 - General Requirements.
 - 2. Substitute items will be allowed only under the conditions specified in the General Conditions and Division 1 of the specifications.
 - C. The Contractor shall not install or fabricate any items without receiving accepted shop drawings from the Engineer for those sections requiring submittals.
 - D. Refer to Division 1 for submittal requirements.
- 1.17. PAINTING
- A. The Division 16 Contractor shall be responsible for touch-up painting and repair of surfaces that are specified to be factory finished.
- 1.18. CEILINGS
- A. The Division 16 Contractor shall install ceiling mounted electrical devices centered in the ceiling panels or tiles.
 - B. All ceiling mounted devices, including sprinkler heads, speakers, microphones, lights, diffusers, smoke detectors and other ceiling devices shall be centered within the individual ceiling panels in both directions. The only exception to this requirement shall be the specific cases indicated on the drawings where "offsets from center" are specified.
 - C. The final locations of ceiling mounted devices shall be based upon the actual ceiling grid layout, not on the drawings. The Contractor shall not "scale" drawings to determine the location of the ceiling mounted devices.

1.19. OPENINGS, CUTTING AND PATCHING

- A. The Division 16 Contractor shall be responsible for cutting openings in existing walls, floor or ceilings for conduit and electrical devices in these structures. Patching shall match adjacent materials and surfaces and shall be performed by craftsmen skilled in the respective craft required.

END OF SECTION 16010

**SECTION 16111
CONDUIT SYSTEMS****PART 1 - GENERAL**

1.1 SECTION INCLUDES

- A. Conduit systems
 - 1. Metal conduit.
 - 2. Flexible metal conduit.
 - 3. Liquidtight flexible metal conduit.
 - 4. Electrical metallic tubing.
 - 5. Nonmetallic conduit.
 - 6. Hangers and supports.
- B. Outlet and device boxes.
- C. Pull and junction boxes

1.2 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers - boxes:
 - 1. Raco
 - 2. Steel City
 - 3. Appleton

2.2 MATERIALS

- A. The materials used in the fabrication of the conduit system shall be products of a manufacturer regularly engaged in the manufacturing of the specified material. Where a manufacturer is named for a particular material, the material of other manufacturer shall be acceptable provided the material meets requirements of the Specification.
- B. Rigid Conduit: Full weight, threaded, rigid steel conduit, galvanized inside and out by hot-dip or electro-galvanizing process. Provide thread protective caps and coupling plugs to prevent injury to threads during handling.
 - 1. Use rigid conduit for all conduit regardless of size where installed in exposed exterior locations, earth fill or in poured concrete walls, columns, floors or other concrete structures.
- C. Electrical Metallic Tubing: Thinwall, electrically welded cold rolled steel conduit, galvanized inside and out by electro-galvanized process. Use for conduit installed in stud walls, masonry walls, above suspended ceilings and where exposed in interior locations.
- D. Flexible Metal Conduit: Formed of one continuous length of spirally wound electro-galvanized steel strip. Use for: Final connections to motor operated equipment, connections to dry type transformers, connections from junction boxes to lighting fixtures, and for wiring within casework and millwork.
- E. Liquid tight Flexible Metal Conduit: Formed of one continuous length of spirally wound steel strip, with water and oil tight neoprene jacket. Use for final connections to equipment located in wet areas and at all exterior locations.
- F. Intermediate Metal Conduit (IMC): May be used as approved by Code for 2 inches and larger where rigid conduit is specified, except shall not be used for conduit buried in earth fill.
- G. PVC Conduit: Schedule 40 or 80 as called for, 90°C. conduit shall be composed of polyvinyl chloride and shall conform to NEMA Standards. Conduit fittings and cement shall be by the same manufacturer. PVC conduit may be used for 1 inches and larger installations where buried outside of the building, and where encased in concrete or below concrete slabs.
- H. Rigid Conduit Fittings: Threaded, galvanized steel/malleable bushings, and concrete tight. Grounding lug type with nylon insulated bushings for connections at cabinets, boxes and gutters.

- I. Metallic Tubing Fittings: Compression type galvanized malleable iron or steel, water and concrete tight. Connectors with nylon insulated throats at cabinets, boxes and gutters.
- J. Flexible Metal Conduit Fittings: Screw-in type galvanized malleable iron or steel with nylon insulated throats.
- K. Liquidtight Flexible Conduit Fittings: Galvanized malleable iron or steel with watertight gaskets, "O" ring and retainer, and nylon insulated throats.
- L. Condulet Fittings: Exposed conduit fittings shall be Condulet type for sharp turns and tees. Minimum radius shall be compatible with the cable to be installed.
- M. Material, size and installation for outlet boxes shall comply with NFPA 70 - National Electrical Code (NEC).
- N. Boxes:
 - 1. In stud walls: For single outlet use 4 inches square by 2-1/8 inches deep box. For ganged outlets use 4-1/2 inches high by 2-1/8 inches deep multiple gang boxes. Boxes to be provided with raised covers of depth as required for thickness of wall materials.
 - 2. In masonry and poured concrete walls: For single outlets requiring two conduit connections in top and/or bottom of box use 4 inches square by 2-1/8 inches deep box with raised square cut cover. For ganged outlets use 3-3/4 inches high by 2 1/2 inches deep multiple gang masonry boxes.
 - 3. Surface mounted wall outlets: For single outlet and double outlets use 4 inches square by 2-1/8 inches deep box. For more than two ganged outlets use 3-3/4 inches x 2 1/2 inches deep multiple gang masonry boxes. Boxes to be provided with 1/2 inches raised cover as required for device.
 - 4. In suspended ceilings: Use 3-1/2 inches deep octagon box with fixture studs and steel mounting bars.
 - 5. In poured concrete ceiling slabs: Use octagon concrete rings with back plates.
- O. Construction, sizes and installation of pull and junction boxes shall comply with NFPA 70 National Electrical Code (NEC).
- P. Pull and junction boxes not specifically described in NFPA 70 - National Electrical Code (NEC), shall be fabricated of minimum 14 gauge galvanized steel with screw covers.
- Q. Pull and junction boxes for installation in poured concrete floors shall be flush type, cast iron, with watertight gasketed covers. Boxes for installation in floors with tile or carpet floor covering shall have recessed covers to accommodate the floor covering.
- R. Pull and junction boxes for outdoor installations shall be NEMA 3R rated.
- S. Construction, sizes and installation of auxiliary gutters shall comply with NFPA 70 - National Electrical Code (NEC).
- T. Provide conduit hanger and support devices of approved type for method of supporting required, to include: Structural steel members, suspension rods, conduit clamps, concrete inserts, expansion shields and beam clamps. All devices shall have galvanized finish or other approved corrosion resistant finish. In general, hangers and supports shall be as follows:
 - 1. Where single or multiple run of conduit is routed on surface of structure: Use conduit clamps mounted on Unistrut channel to maintain 1 inch (minimum) clearance between conduit and structure.
 - 2. Where single run of conduit is suspended from overhead: Use split ring conduit clamp suspended by threaded steel drop rod.
 - 3. Where multiple parallel runs of conduit are suspended from overhead: Use split ring conduit clamps uniformly spaced and supported on trapeze hangers fabricated of channels, suspended by not less than 3/8 inch threaded steel drop rod.
 - 4. Where conduit is buried in concrete floor slabs: Anchor conduit to structural floor with conduit straps, at 10'-0 inches intervals.
 - 5. Maximum hanger and support spacing shall be in accordance with NFPA 70 - National Electrical Code (NEC). Regardless of listed spacing provide additional hangers or supports at not more than 2 feet -0 inches from each change of direction and at each side of any box or fitting.
 - 6. Metal straps or tie wires shall not be used to support conduit, box or other raceways.

- U. Hangers and supports shall be anchored to structure as follows:
 1. Hangers and supports anchored to poured concrete: Use malleable iron or steel concrete inserts attached to concrete forms.
 2. Hangers or supports anchored to precast concrete: Use self-drilling expansion anchors. Expansion shields may be used where concrete inserts have been missed or additional support is required in poured concrete.
 3. Hangers or supports anchored to structural steel: Use beam clamps and/or steel channels as required by structural system.
 4. Hangers or supports anchored to metal deck: Use drill-in expansion anchors.
 5. The use of explosive force hammer actuated, booster assist or similar anchoring device will not be permitted.
- V. Conduits 3 inches diameter and larger, rigidly secured to building construction on opposite sides of a building expansion joint shall be provided with expansion and deflection couplings. The couplings shall be installed in accordance with the manufacturer's instructions.
- W. Conduits smaller than 3 inch diameter shall be provided with junction boxes on both sides of the expansion joint and connected by 15 inches of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of flexible conduit, expansion and deflection couplings as specified above may be installed.

PART 3 - EXECUTION

3.1 CONDUIT INSTALLATION

- A. Install conduit in accordance with NECA "Standard of Installation."
- B. Horizontal runs of conduit shall be installed in ceiling plenum. Conduit for convenience outlets, wall mounted fixtures and other wall outlets shall be routed overhead and dropped through wall to the outlet. Conduit shall not be installed in concrete floor slabs except where conditions will not permit the conduit to be routed overhead. Conduit shall be supported from the building structure and conduits shall be supported independently from mechanical system components.
- C. Conduit shall be concealed, except in crawl spaces, tunnels, shafts, mechanical equipment rooms, and at connections to surface panels and free standing equipment, and as otherwise noted.
- D. Conduit shall be routed in lines parallel to building construction.
- E. No conduit shall be installed less than 6 inches from piping.
- F. Certain conduits are permitted to be embedded in structural concrete work:
 1. Reinforcing steel shall be securely anchored in place before installing conduit.
 2. No steel reinforcing shall be displaced from plan dimensions without approval of the Architect.
 3. Conduit shall not be placed over top of reinforcing or under bottom of reinforcing.
 4. Conduit and fittings shall not displace concrete in columns in excess of 4% of total cross-section area of column without approval of the Architect.
 5. Conduit shall not be placed closer than three diameters on center.
 6. Maximum size of embedded conduit or pipe shall not exceed 1/3 thickness of structural slab; 2/3 thickness of topping slab.
- G. Minimum size conduit shall be ½ inch for power, control and lighting. and 3/4 inch for communications applications. Where specific sizes required by Drawings or Specifications are larger than Code requirements, the larger size shall be provided. Size conduits for type THW insulated wire.
- H. Install the conduit system mechanically and electrically, continuous from outlet to outlet and to cabinets, junction or pull boxes. Conduit shall enter and be secured to cabinets and boxes in such a manner that all parts of the system will have electrical continuity.
- I. Where cable trays are installed for communications cables, conduit shall be installed from the equipment junction box to the cable tray.
- J. Communications conduit bends shall be made so that the radius of the curve of the inner edge is not less than ten times the conduit outside diameter.
- K. Install a nylon braided polyester or propylene pull cord with 12 inches minimum slack at the ends for each empty communications conduit.

3.2 OUTLET BOX INSTALLATION

- A. Outlet boxes shall be installed for fixtures, switches, receptacles and other devices.
- B. Approximate location of outlets are shown on the plans, but each outlet location shall be checked by the Contractor before installing the outlet box.
- C. Wall boxes installed flush in common wall shall not be back-to-back or through-wall type.
- D. Boxes located on opposite sides of a common wall that are closely connected by conduit shall have the conduit openings plugged with duct seal (use fire safing material to plug the nipple in rated fire and/or smoke walls).
- E. Outlet boxes shall be installed plumb and square with wall face and with front of plaster ring located within 1/8 inches of face of finish wall. Boxes in masonry shall be set with bottom of the box tight to the masonry unit.
- F. All outlet boxes shall be securely fastened on at least both sides.
- G. Outlet and backboxes shall be supported independently of the ceiling material.
- H. Outlet and backboxes shall be supported independently of the conduit system.

3.3 PULL AND JUNCTION BOX AND GUTTER INSTALLATION

- A. Install pull boxes, junction boxes and auxiliary wiring gutters where required to facilitate installation of the wiring.
- B. For concealed conduit, install boxes flush with ceiling or wall, with covers accessible and easily removable. Where flush boxes are installed in finished ceilings or walls, provide cover which shall exceed the box face dimensions by a sufficient amount to allow no gap between box and finished material.
- C. Pull and junction boxes shall not be located in finished, occupied rooms, without prior approval of Architect.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Arrange supports to prevent misalignment during wiring installation.
- B. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports
- C. Do not attach conduit to ceiling support wires.
- D. Hangers and supports shall be installed for all conduit and boxes.
- E. Conduit, fittings, raceways and boxes shall not be attached to or supported from mechanical pipes, plumbing pipes, sheet metal ducts, or suspended ceiling support wires.

END OF SECTION 16111

**SECTION 16120
WIRE AND CABLE**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wiring systems, 600 volts and less

PART 2 - PRODUCTS

2.1 MATERIALS

- A. This Section describes the basic materials and methods of installation for general wiring systems of 600 volts and less. Wiring for a higher voltage rating shall be as specified in other sections.
- B. Minimum size conductors shall be No. 12 AWG for power and lighting circuits and No. 14 AWG or per manufacturer recommendation for signal and control circuits.
- C. The material used for the wiring systems shall be the products of a manufacturer regularly engaged in the manufacturing of the specified material. Where a manufacturer is named for a particular material, the material of other manufacturers will be acceptable provided the material meets requirements of the Specifications.
- D. Wire and cable for power, lighting, control and signal circuits shall have copper conductors of not less than 98% conductivity. Power, lighting and control wire and cable shall be insulated to 600 volts. All conductors larger than #10 AWG shall be stranded.
- E. Type of wire and cable for the various applications shall be as follows:
 - 1. Type THW, THWN or XHHW (75°C.): Use for branch circuits, panel and equipment feeders in wet and dry locations.

2.2 CONDUCTOR COLOR CODING

- A. Wiring systems shall be color coded. Conductor insulation shall be colored in sizes up through #10 AWG, conductors #8 AWG and larger shall have black insulation and shall be phase color coded with 1/2" band of colored tape at all pull boxes, junctions and terminations. Colors shall be assigned to each conductor as described below and carried throughout all main and branch circuit distribution.

	<u>120/208 Volt</u>	<u>120/240 Volt</u>	<u>277/480 Volt</u>
1. Phase "A" conductor -	Black	Black	Brown
2. Phase "B" conductor -	Red	Red	Orange
3. Phase "C" conductor -	Blue	--	Yellow
4. Neutral conductor -	White	White	Grey
5. Grounding conductor -	Green	Green	Green

2.3 CONNECTORS

- A. In-line splices and taps for conductor sizes #8 AWG and smaller: Use 3M Company "Scotchloc" vinyl insulated spring connectors or Engineer approved equivalent.
- B. In-line connectors for conductor sizes #6 AWG and larger: Use Thomas & Betts two way connectors long barrel type, Series 54800 with Interlocking Covers or Engineer approved equivalent.
- C. Taps for conductor sizes #6 AWG and larger: Use Thomas & Betts "C" Taps, Series 54700 or Engineer approved equivalent.
- D. Cable terminations to busbars, switch studs and terminal blocks: Use Thomas & Betts two hole lugs, long barrel type, Series 54800 or Engineer approved equivalent.
- E. Insulate splices and taps to thickness of conductor insulation with half-lapped layers of 3M Company "Scotch" brand No. 88 vinyl electrical tape or Engineer approved equivalent. Connectors having irregular surfaces: Fill voids and smooth contours with 3M Company "Scotchfil" electrical putty prior to taping.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Verify that mechanical work which is likely to injure conductors has been completed.

3.2 PREPARATION

- A. Conduit shall be swabbed free of moisture and debris prior to pulling in wire.

3.3 INSTALLATION

- A. Neatly train and secure wiring inside boxes, equipment, and panelboards.

- B. Use wire pulling lubricant for pulling 4 AWG and larger wires.
- C. Support cables above accessible ceilings to keep them from resting on ceiling tiles.
- D. Make splices, taps, and terminations to carry full ampacity of conductors without perceptible temperature rise.
- E. Terminate spare conductors with electrical tape.
- F. Cable for all feeders shall be continuous from origin to termination.
- G. Splices in branch circuit wires shall be made only in accessible junction boxes.
- H. Power feeder cable shall be pulled with cable lubricating compound suitable for the wire insulation and conduit it is used with. Compound shall not harden or become adhesive.

END OF SECTION 16120

**SECTION 16140
WIRING DEVICES AND PLATES**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Wiring devices and plates

1.2. SUBMITTALS

- A. Submit catalog cuts and data for switches, receptacles and cover plates necessary to evaluate the proposed devices.

PART 2. PRODUCTS

2.1. MANUFACTURERS

- A. Acceptable manufacturers:
 - 1. Hubbell
 - 2. Eagle
 - 3. Leviton
 - 4. Pass & Seymour
 - 5. Slater
 - 6. Design Professional approved equivalent.
- B. Catalog numbers are based on Hubbell.

2.2. MATERIALS

- A. All wiring devices shall be Heavy Duty, "Specification Grade" except where otherwise indicated.
- B. Wall light switches shall be Ivory color:
 - 1. Single pole toggle light switch- 20 amp, 120-277 volt.
 - 2. Three way toggle light switch – 20 amp, 120-277 volt.
- C. Receptacles shall be "Specification Grade."
 - 1. Duplex receptacle - 2 pole, 3 wire, grounding type, side or back wired, 20 amp, 125 volt.
 - 2. Receptacle color - Ivory
 - 3. Duplex receptacles, GFCI type, 2 pole, 3 wire, grounding type, 20 amp, 125 volt.
- D. Receptacles for power and special purpose outlets shall have characteristics and NEMA configurations per Electrical drawings.
- E. Cover Plates: Provide plastic cover plates for wiring devices, same color as wiring devices.
- F. Provide weather proof housings with hinged covers for plates for receptacles installed outdoors or in wet locations.

PART 3. EXECUTION

3.1. EXAMINATION

- A. Verify that outlet boxes are installed at proper height.
- B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2. PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.3. INSTALLATION

- A. Install in accordance with NECA "Standard of Installation."
- B. Install devices plumb and level.
- C. Install switches with OFF position down.
- D. Receptacles shall be installed with the grounding pole located at the bottom.
- E. In masonry walls, switches and receptacle heights shall be adjusted as required so outlets are at nearest mortar joint to indicated height.
- F. Where light switches are located adjacent to doors, they shall be installed on "knob" side of door, unless indicated otherwise.
- G. Prior to roughing-in outlet boxes, verify door swings, type of wall finishes and locations for counters.

3.4. INSTALLATION OF WIRING DEVICES

- A. Switches and receptacles shall be installed and located as follows, unless noted otherwise on Drawings.
 - 1. Switches: 48 inches above finished floors.
 - 2. Receptacles: 18 inches above finished floors generally; 36 inches above finished floors or 8 inches above counters and work benches in kitchens, shops, mechanical equipment rooms and similar areas.
- B. In masonry walls, switches and receptacle heights shall be adjusted as required so outlets are at nearest mortar joint to specified height.
- C. Where walls have wainscot finish, switch height shall be adjusted as required, so switch is either all in wainscot or all in wall above wainscot.
- D. Prior to roughing-in outlet boxes, Contractor shall verify from general construction drawings; door swings, type of wall finishes and locations for counters and work benches.
- E. For all switches and receptacles, Contractor shall verify and if necessary provide and install an extension to bring back box to within 1/8 inch of finished surface.
- F. Install in accordance with NECA "Standard of Installation."
- G. Install devices plumb and level.
- H. Install switches with OFF position down.
- I. Install receptacles with grounding pole on bottom.
- J. Connect wiring device grounding terminal to outlet box with bonding jumper.
- K. Install cover plates on switch, receptacle, and blank outlets in all areas.
- L. Connect wiring devices by wrapping conductor around screw terminal.

END OF SECTION 16140

**SECTION 16160
CIRCUIT BREAKER PANELBOARDS**

PART 1 - GENERAL

- 1.1 SECTION INCLUDES
 - A. Branch circuit panelboards
- 1.2 SUBMITTALS
 - A. Submit shop drawings including fabrication details, lug and bus arrangement, ampere and voltage rating, breaker frame sizes and interrupting ratings.
- 1.3 STANDARDS AND CODES
 - A. Fabrication and installation shall comply with applicable Sections of NEC, Article 384, and shall bear UL listing.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
 - A. Acceptable manufacturers:
 - 1. Square D
 - 2. General Electric
 - 3. Siemens
 - 4. Design Professional approved equivalent
- 2.2 DESCRIPTION
 - A. Panelboards described in this Section shall be dead-front, safety type furnished with thermal-magnetic molded case circuit breakers.
 - B. Panelboards shall be for lighting, receptacle and applicable branch circuit and power distribution applications. Circuit breakers shall have ratings as scheduled on Drawings.
 - C. Branch circuit panelboards shall be equivalent to Square D type NQOD or NQ.
- 2.3 PANELBOARDS
 - A. Bussing Assembly and Temperature Rise:
 - 1. Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on the panelboard schedule.
 - 2. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type. Single-phase, three-wire panelboard bussing shall be such that any two adjacent single-pole breakers are connected to opposite polarities in such a manner that two-pole breakers can be installed in any location.
 - 3. Three-phase, four-wire bussing shall be such that any three adjacent single-pole breakers are individually connected to each of the three different phases in such a manner that two or three-pole breakers can be installed at any location.
 - 4. Current-carrying parts of the bus assembly shall be plated. Mains ratings shall be as scheduled on the plans. Equipment ground bus shall be provided for panels. All bus shall be copper.
 - B. Safety Barriers: The panelboard interior assembly shall be dead front with panelboard front removed.
 - C. Cabinets and Fronts:
 - 1. Panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL Standard 50 for cabinets. Wiring gutters shall be in accordance with UL Standard 67 for panelboards.
 - 2. Fronts shall include doors and have flush, brushed stainless steel, cylinder tumbler-type locks with catches and spring-loaded door pulls.
 - 3. The flush lock shall not protrude beyond the front of the door. All panelboard locks shall be keyed alike.
 - 4. Front shall have adjustable indicating trim clamps which shall be completely concealed when the doors are closed. Doors shall be mounted by completely concealed steel hinges. Fronts shall not be removable with door in the locked position.
 - 5. A circuit directory frame and card with a clear plastic covering shall be provided on the inside of the door.

6. The directory card shall provide a space at least 1/4 inch high x 3 inches long or equivalent for each circuit. The directory shall be typed to identify the load type fed by each circuit and room area(s) served.
 7. Fronts and cabinets shall be of code gauge, full finished steel with rust-inhibiting primer and baked enamel finish.
 8. Box width shall be 26 inches wide (maximum) for surface mounted panels and 8.6 inches wide (maximum) for column width panels.
- D. Wiring Terminals:
1. Terminals for feeder conductors to the panelboard mains and neutral shall be UL listed as suitable for the type of conductor specified.
 2. Terminals for branch circuit wiring, both breaker and neutral, shall be UL listed as suitable for the type of conductor specified.
- E. Circuit Breakers:
1. Circuit breakers shall be quick-make, quick-break, thermal magnetic, trip indicating, and have common trip on all multi-pole breakers.
 2. Circuit breakers shall be equipped with individually insulated, braced and protected connectors. Circuit breakers rated for 120/208/240 VAC service shall be plug-on type, circuit breakers rated for 277/480 VAC service shall be bolt-on type. The ampere rating of all circuit breakers shall be visible on the circuit breaker handle.
 3. The front faces of circuit breakers shall be flush with each other. Large permanent individual circuit numbers shall be affixed to each breaker in a uniform position (or equip each breaker with a circuit card holder and neatly printed card identifying the circuit).
 4. Tripped indication shall be clearly shown by the breaker handle taking a position between ON and OFF.
 5. Provisions for additional breakers shall be such that no additional connectors will be required to add breakers.
- F. Integrated Equipment Rating:
1. Each panelboard, as complete unit, shall have a rating equal to or greater than the integrated equipment rating shown on the panelboard schedule. Such rating shall be established by factory test with the circuit breakers mounted on the panelboard.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Securely anchor panelboards to structure and make feeder and branch circuit connections.
- B. All recessed panelboards shall have a minimum of five 3/4 inches diameter empty conduit stubs, from the panelboard to the ceiling space above.
- C. Install typewritten circuit directory for each panelboard.

END OF SECTION 16160

**SECTION 16161
INTEGRATED SURGE PROTECTIVE DEVICE (SPD)
FOR PANELBOARDS**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Description
 - 1. Integrated Surge Protective Device (SPD).

1.2. REFERENCES

- A. UL 1449 Second Edition 2005 - SPD
- B. UL 1283 - Electromagnetic Interference Filters
- C. ANSI/IEEE C62.41.1-2002 - IEEE Guide on the Surge Environment in Low Voltage (1000 V and Less) AC Power Circuits; C62.41.2-2002 - IEEE Recommended Practice on Characterization of Surge Voltages in Low Voltage AC Power Circuits; and C62.45-2002 - IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
- D. NEC 2008, Article 285

PART 2. PRODUCT

2.1. SURGE PROTECTIVE DEVICE

- A. Integral Surge Suppressor
 - 1. SPD shall be Listed in accordance with UL 1449 Second Edition 2005 and UL 1283, Electromagnetic Interference Filters.
 - 2. SPD shall provide suppression for all modes of protection: L-N, L-G, and N-G in WYE systems.
 - 3. The manufacturer of the SPD shall be the same as the manufacturer of the panelboard in which the devices are installed and shipped.
 - 4. SPD ratings:
 - a. Minimum surge current rating shall be 80 kA per phase (40 kA per mode) for panelboards.
 - b. UL 1449 clamping voltage must not exceed the following:
- | <u>VOLTAGE</u> | <u>L-N</u> | <u>L-G</u> | <u>N-G</u> |
|----------------|------------|------------|------------|
| 208Y/120 | 400V | 400V | 400V |
| 480Y/277 | 800V | 800V | 800V |
- 5. Visible indication of proper SPD connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable. The status of each SPD module shall be monitored on the front cover of the enclosure as well as on the module. A push-to-test button shall be provided to test each phase indicator. Push-to-test button shall activate a state change of dry contacts for testing purposes.
 - 6. SPD shall be equipped with an audible alarm which shall activate when any one of the surge current modules has reached an end-of-life condition. An alarm on/off switch shall be provided to silence the alarm. The switches and alarm shall be located on the front cover of the enclosure.
 - 7. A connector shall be provided along with dry contacts (normally open or normally closed) to allow connection to a remote monitor or other system. The output of the dry contacts shall indicate an end-of-life condition for the complete SPD or module.
 - 8. Terminals shall be provided for necessary power and ground connections.

2.2. MANUFACTURERS

- A. Approved Manufacturers.
 - 1. Square D
 - 2. General Electric
 - 3. Siemens
 - 4. Design Professional Approved Equivalent.

END OF SECTION 16161

**SECTION 16170
DISCONNECT SWITCHES**

PART 1 - GENERAL

- 1.1 SECTION INCLUDES
 - A. Disconnect switches for all equipment and motors
- 1.2 SUBMITTALS
 - A. Submittals shall include catalog cuts, fabrication details, ratings and other pertinent data required to evaluate the proposed equipment.
- 1.3 STANDARDS AND CODES
 - A. Except where otherwise required by this Section, the following Standards and Codes shall govern:
 - 1. NEC Article 380
 - 2. UL listed

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
 - A. Acceptable manufacturers - Disconnect switches for fractional horsepower motors less than 1/2 horsepower and less than 125 volts:
 - 1. Bussmann
 - 2. General Electric
 - 3. Hubbell
 - 4. Design Professional approved equivalent
 - B. Acceptable manufacturers – 3 Phase Disconnect switches:
 - 1. Square D
 - 2. General Electric
 - 3. Siemens
 - 4. Design Professional approved equivalent
- 2.2 EQUIPMENT
 - A. Disconnects for fractional horsepower motors, less than 1/2 horsepower, and less than 125 volts, and for equipment of similar capacity and voltage shall be Bussman types as follows:
 - 1. Type SRY mounted on 4 inches square box, for plug-in equipment in unfinished areas.
 - 2. Type SRW mounted on 2-3/4 inches switch box, for plug-in equipment in finished areas, installed on flush switch box.
 - 3. Type SSY mounted on 4 inches square box, for direct connected equipment in unfinished areas.
 - 4. Type SSW mounted on 2-3/4 inches switch box, for direct connected equipment in unfinished areas, installed on flush switch box.
 - B. Disconnects for integral horsepower motors, 1/2 horsepower and larger, and for equipment of similar capacity shall be heavy duty industrial type, fusible or non-fusible as indicated, with solid neutrals where required. At interior locations enclosures shall be NEMA type 1; at exterior locations enclosures shall be NEMA type 3R.
 - C. Disconnects for integral horsepower motors shall have provision for padlocking in the "OFF" positions.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Install disconnect switches as indicated, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that disconnect switches comply with applicable requirements of NEC and UL standards.
 - B. Install fuses in fusible switches.

END OF SECTION 16170

**SECTION 16400
ELECTRICAL SERVICE AND DISTRIBUTION**

PART 1. GENERAL

1.1. SECTION INCLUDES

A. Electric service entrance and metering

1.2. RELATED WORK

A. Section 16010: Basic Materials and Methods

1.3. WORK BY OTHERS

A. Primary service, transformers, and meters will be provided by Utility Company.

1.4. SYSTEM DESCRIPTION

A. Electric service system will be 120/240 volts, single phase, three wire, with ground, 60 Hz.

1.5. REGULATORY REQUIREMENTS

A. Conform to requirements of Utility Company.

B. Conform to National Electric Code, current addition.

PART 2. PRODUCTS

2.1. NONE

PART 3. EXECUTION:

3.1. INSTALLATION

A. Electrical Contractor shall install equipment and connect in accordance with utility company's requirements and electrical codes.

B. Electrical Contractor shall pay all utility company fees.

END OF SECTION 16400

**SECTION 16450
GROUNDING & BONDING**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Grounding electrodes and conductors
- B. Ground grid
- C. System grounding:
 - 1. Secondary service neutrals shall be grounded at the secondary disconnecting means.
- D. Bonding

PART 2. PRODUCTS

2.1. GROUNDING WIRES

- A. Grounding wires shall be UL and NEC approved types, copper, insulated and color identified green, except where indicated otherwise.
- B. Wire size shall not be less than that indicated on the drawings and not less than required by the NEC.

2.2. GROUND RODS

- A. Ground rods shall be copper-clad steel, 3/4 inch diameter x 10 feet - 0 inches long.

2.3. GROUNDING SYSTEM

- A. Lighting fixtures, receptacles and fixed equipment shall be bonded and grounded in accordance with the National Electrical Code or as indicated.
- B. Ground for wiring systems shall be obtained by extending insulated ground conductor throughout the system from the service entrance point. Equipment ground conductors shall be sized in accordance with NEC.
- C. The maximum resistance of the grounding system shall not exceed 3 ohms under normally dry conditions. Reading shall be constant for at least 3 minutes. If this resistance is not obtained, additional ground rods shall be installed.

2.4. GROUND GRID

- A. Install a ground grid which shall consist of three ground rods spaced 8'-0 inches apart connected by #4/0 AWG ground wire Cadwelded to the ground rods.
- B. Extend the #4/0 AWG ground wire from the ground grid to the ground bus in the service panel.

2.5. GROUNDING CONNECTIONS AT WATER SERVICE

- A. Install a #4/0 AWG ground wire in 3/4 inch rigid conduit from the ground bus in the service panel to the incoming water service.
- B. Install a ground clamp at the water service to connect the ground wire to the service.

2.6. GROUNDING CONNECTIONS AT BUILDING

- A. Install a #4 AWG ground wire from the ground bus in the service panel to the rebar in the building foundation.
- B. Install a #4 AWG grounding wire from the ground bus in the service panel to the building structural steel.

2.7. CONCRETE ENCASED GROUNDING ELECTRODE

- A. Install a concrete encased grounding electrode per NEC 250.52 (A)(3).
- B. Install a #4 AWG ground wire from the ground bus in the service panel to the encased electrode.

PART 3. EXECUTION

3.1. INSTALLATION

- A. Grounding shall be in accordance with NEC and indicated in the Contract Documents.
- B. Metallic conduit: Metallic conduits which terminate without mechanical connection to a housing of electrical equipment by means of a locknut and bushing or adapters, shall be provided with grounding bushings. Bushings shall be connected with a bare grounding conductor to the equipment ground bus.
- C. Connect the secondary service neutral to the ground bus in the service equipment.
- D. Conduit System:
 - 1. Ground all metallic conduit systems

2. Conduit provided for mechanical protection containing only a grounding conductor shall be bonded to that conductor at the entrance and exit from the conduit.
- E. Feeders: Install green grounding conductors with all feeders as indicated.
- F. Boxes, cabinets, enclosures and panelboards:
1. Bond the grounding wires to each pullbox, junction box, outlet box, cabinets and other enclosures through which the ground wires pass.
 2. Provide lugs in each box and enclosure for ground wire termination.
 3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs for terminating the ground wires.
- G. Motors and starters:
1. Provide lugs in motor terminal box and starter housing for ground wire termination.

END OF SECTION 16450

**SECTION 16471
BRANCH CIRCUIT WIRING**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Feeder and branch circuits

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION - FEEDER CIRCUITS

- A. Lay out the feeders generally as indicated, but determine the exact location and routing of feeders to best fit the layout of the work.
- B. Where conductor sizes for feeder circuit are not indicated, provide feeder circuits with conductors sized as follows:
 - 1. Feeders, serving an individual branch circuit panel, or an individual power distribution panel, shall have conductors with ampere capacity of not less than the capacity of the panel mains.
 - 2. Feeders, serving more than one branch circuit panel, or more than one power distribution panel, shall have conductors with ampere capacity of not less than the combined ampere capacity of all panel mains, served by the feeder.

3.2 INSTALLATION - BRANCH CIRCUITS

- A. Receptacles and appliances shall be on separate circuits from lighting.
- B. Branch panel circuits are numbered to match NEMA pole numbering system; poles 1 and 2 - Phase A, poles 3 and 4 - Phase B, poles 5 and 6 - Phase C, etc. Actual field numbering of circuit directories may vary from pole numbers, but shall be phased and pole connected.
- C. No. 14 wire will be permitted only on control circuits of relays, contactors, starters. No. 12 wire shall be minimum size for lighting, motor, or general branch circuits.
- D. Where conductor sizes for such circuits are not indicated, provide branch circuits with conductors sized as follows:
 - 1. Conductors for individual motor branch circuits shall have ampere capacity of not less than 125% of the running current of the motors.
 - 2. Conductors for multiple motor branch circuits shall have ampere capacity of not less than 125% of the running current of the largest motor plus 100% of the running current for each additional motor connected to the circuit.
 - 3. Conductors for individual or multiple equipment branch circuits shall have an ampere capacity of not less than 125% of the total connected ampere load served by the branch circuit.
- E. Conductor sizes for lighting, receptacles and small motor branch circuits, with less than 20 ampere connected load shall be sized as follows:
 - 1. Conductor size for branch circuits 75 feet-0 inches in length from branch circuit panel to center of load shall not be smaller than No. 12; up to 125 feet-0 inches, not smaller than No. 10; up to 175 feet-0 inches, not smaller than No. 8.
- F. Where specific conductor sizes required are larger than Code requires, the larger sizes shall be installed.
- G. Do not use shared neutral conductors.

END OF SECTION 16471

**SECTION 16476
FUSES**

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fuses

PART 2 - PRODUCTS

2.1 FUSES

- B. Low voltage current-limiting fuses, types as specified below, shall be UL listed in accordance with Standards 198C and 198E and CSA certified HRC in accordance with Standard C22.2 No. 106-M1992.
- C. Fuses shall be by BUSSMAN, GOULD-SHAWMUT or LITTLEFUSE, types and ratings as follows:
 - 1. UL Class R, Low-Peak Dual Element Current Limiting, Type LPN-R and LPS-R, 200,000 ampere interrupting rating; use for circuits 600 ampere or less, and motors above one-half horsepower.
 - 2. UL Class S, Fustat Dual element, 10,000 ampere interrupting rating; use for general purpose circuits up to 30 ampere, and fractional horsepower motors, 125 volt or less.
- D. Fuses for feeders, branch circuits, motors and other equipment shall be selected in types and ratings in accordance with NEC to provide a coordinated system of overcurrent protection, thus in case of a fault or harmful overload, only the fuses nearest the fault or overload will open.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fuses in fusible disconnect switches.

END OF SECTION 16476

**SECTION 16510
LIGHTING FIXTURES & LAMPS**

PART 1 - GENERAL

- 1.1 SECTION INCLUDES
 - A. Lighting fixtures, ballasts, and lamps
- 1.2 SUBMITTALS
 - A. Submit catalog cuts of all lighting fixtures showing cuts and photometric data properly identified for approval before construction.
 - B. Submit catalog cuts of all ballasts.
 - C. Submit catalog cuts of all lamps.
- 1.3 STANDARDS AND CODES
 - A. The following standards and codes apply:
 - 1. NEC Article 410
 - 2. UL Listings

PART 2 - PRODUCTS

- 2.1 LIGHTING EQUIPMENT
 - A. Lighting equipment shall be as scheduled and as specified or Architect approved equivalent. Architect's decision final as to all substitute fixtures.
 - B. Mounting as specified in schedule; if question arises, Design Professional's decision shall govern mounting height, etc.
 - C. For all fluorescent equipment, unless otherwise noted, shall be equipped with harmonically filtered electronic ballast.
 - D. Furnish fixtures with dimming ballasts where fixtures are shown on the drawings as being controlled by wall box dimmers.
 - 1. Verify that electronic wall box dimmers are compatible with electronic ballasts.
- 2.2 LAMPS
 - A. All fluorescent lamps shall be 4100° K unless noted otherwise:
 - B. Provide lamps for all fixtures as scheduled on the drawings.
 - C. Compact fluorescent lamps shall be (4100°K) 9w, 13w, 18w, 26w, 28w.
 - D. High pressure sodium lamps shall be clear 2100° K unless otherwise noted.
 - E. Metal halide lamps shall be clear, protected type, 3000° K unless otherwise noted

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. To be installed by skilled and experienced mechanics in workmanlike manner, all runs straight and true and level. Wiring continuous from splice in outlet box to fixture. All connections made with wirenuts or other approved solderless connector.
 - B. Contractor responsible for all fixtures and lamps until acceptance by Architect.
 - C. Prior to placing orders for recessed fluorescent fixtures, verify the types of ceilings and suspension that have been approved for this project and order fixtures with flanges as required to fit in the ceilings.
 - D. Prior to placing orders for all lighting fixtures, verify with other sections providing equipment that lighting fixtures will fit in the indicated locations.

END OF SECTION 16510

**SECTION 16511
LIGHTING CONTROL SYSTEM**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Daylight and occupancy lighting control system.

1.2. SUBMITTALS

A. General:

- 1. Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Bill of Materials:

- 1. Complete list of all parts

C. Product Data:

- 1. Submit product data, including catalog cut sheets for specified products.

D. Shop and Wiring Drawings:

- 1. Submit shop drawings detailing all mechanical and electrical equipment including one-line diagrams, wire counts, coverage patterns, and physical dimensions of each item.

E. Fixture Compatibility:

- 1. List of ballasts and lamp combinations compatible with occupancy sensors.

F. Closeout Submittals:

- 1. Warranty documents specified herein.

1.3. SYSTEM DESCRIPTION

- A. Control of interior lighting by sensing occupancy.
- B. Manual control of lighting.
- C. Control of interior lighting by time schedule.

PART 2. PRODUCTS

2.1. ACCEPTABLE MANUFACTURER

- A. Wattstopper
- B. Hubbell Building Automation
- C. Cooper Lighting Controls
- D. Design Professional approved equal.

2.2. EQUIPMENT

- A. See schedule on drawings.

PART 3. EXECUTION

3.1. PREPARATION

A. Site Verification.

- 1. Verify that wiring conditions are acceptable for product installation in accordance with manufacturer's instructions.

B. Inspection.

- 1. Inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.

3.2. INSTALLATION

- A. The Electrical Contractor shall coordinate, receive, mount connect and place into operation all equipment. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for properly functioning lighting control and occupancy sensors as described herein and shown on the plans.

B. Compliance

- 1. Contractor shall comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.

C. Power

- 1. The contractor shall test that all branch load circuits are operational before connecting loads to sensor system load terminals, and then de-energize all circuits before installation.

D. Related Product Installation

1. Refer to other sections listed in Related Sections for related product's installation.

3.3. TESTING

- A. Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, a qualified factory representative shall completely check the installation prior to energizing the system. Each installed occupancy sensor shall be tested in the test mode to see that lights turn off and on based on occupancy.
- B. At the time of checkout and testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.

3.4. PROTECTION

- A. Contractor shall protect installed product and finished surfaces from damage during all phases of installation including preparation, testing, and cleanup.

3.5. SUPPORT SERVICES

- A. System Start Up and Commissioning
 1. Manufacturer shall provide a factory authorized technician to confirm proper installation and operation of all lighting control system components. The startup requirement is intended to verify:
 - a. That all occupancy sensors are located, installed, and adjusted as intended by the factory and the contract documents.
 - b. The occupancy sensors are operating within the manufacturers specifications.
 2. Manufacturer to provide a written statement verifying that the system meets the above requirements.
- B. System Training
 1. Manufacturer shall provide factory authorized technician to train owner personnel in the operation, programming and maintenance of the lighting control system including all occupancy sensors.
- C. System Programming
 1. Manufacturer shall provide system programming including:
 - a. Wiring documentation.
 - b. Switch operation.

END OF SECTION 16511

**SECTION 16512
EXTERIOR LIGHTING CONTROLS**

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install exterior lighting control system as described in Contract Documents.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Materials:

1. Exterior Lighting Control:

a. Digital Time Switch:

- 1) 7 day digital time switch, LCD display, permanent schedule retention, 10 hour minimum power outage backup, multiple on and off setting points, capable of different schedules each day of the week, 120 volts, NEMA 1 enclosure.

2) Approved Products.

- a) Intermatic: ET1705PD82.
- b) Paragon: EC7004/120.
- c) Tork: EW101B.

b. Photo Cell:

1) 120 volts.

2) Approved Products.

- a) Intermatic
- b) Paragon
- c) Tork

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting Control:

1. Install time switches inside building to control building exterior lighting. Label each component to identify lighting controlled, I.E. 'BUILDING LIGHTING.' Label with 1/16 inch thick laminated plastic composition material with contrasting color core. Engraved letters shall be 1/4 inch high.
2. Locate photocell(s) outside building under soffit and away from any light source and direct sunlight.
3. Wire photocell and time switch in series for photo cell ON, time switch OFF operation.

END OF SECTION 16512

**SECTION 16570
DIMMING CONTROLS**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Architectural-grade, slide, box-mounted dimmers

1.2. Submittals

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Product Data: Submit product data, including catalog cut sheets for specified products.

1.3. Delivery, Storage and Handling

- A. General: Comply with Division 1 Product Requirements Sections.

PART 2. PRODUCTS

2.1. DIMMERS

A. MANUFACTURERS

- 1. Leviton Manufacturing.
- 2. Lutron
- 3. General Electric
- 4. Design Professional approved equivalent.

B. Fin Dimmer for 120 volt mark incandescent lamps.

- 1. 600 watts, 120 volt
- 2. Equivalent to Leviton – “Monet” #MNI06-10
 - a. Color: White

C. Electrical Specifications

- 1. Input: 120 VAC @60Hz
- 2. Line Voltage Regulation
- 3. RFI Noise Supression

D. Environmental Specifications

- 1. Operating Temperature: 0° C to 55° C or 32° F to 130°F.
- 2. Relative Humidity: non-condensing 20% to 90%.

PART 3. EXECUTION

3.1. PREPARATION

- A. Site verification: verify that wiring conditions, which have been previously installed under other sections or at a previous time, are acceptable for product installation in accordance with manufacturer’s instructions.
- B. INSPECTION: INSPECT ALL MATERIAL INCLUDED IN THIS CONTRACT PRIOR TO INSTALLATION. MANUFACTURER SHALL BE NOTIFIED OF UNACCEPTABLE MATERIAL PRIOR TO INSTALLATION.

3.2. INSTALLATION

- A. The Electrical Contractor, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all equipment. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for properly functioning lighting control and dimming as described herein and shown on the plans. The Electrical Contractor shall maintain performance criteria stated by manufacturer without defects, damage, or failure.
 - 1. Compliance: Contractor shall comply with manufacturer’s product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.
- B. Power: The contractor shall test that all branch load circuits are operational before connecting loads to dimmer system load terminals, and then de-energize all circuits before installation. Contractor shall derate all devices, where applicable.
- C. Related Product Installation: Refer to other sections listed in Related Sections for related products’ installation.

3.3. TESTING

- A. Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, Contractor shall completely check the installation prior to

energizing the system. Each installed dimmer shall be tested for various levels of brightness, and proper ON/OFF operations.

- B. At the time of checkout and testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.

END OF SECTION 16570

**SECTION 16660
WIRING FOR EQUIPMENT FURNISHED BY OTHER SECTIONS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electric services for equipment furnished by mechanical contractor, equipment contractor and the Owner.
- B. In general the equipment to be wired shall include but not be limited to the following:
 - 1. Mechanical equipment.
 - 2. Equipment furnished by other contractors.
 - 3. Door hardware and security equipment.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide services and make final connections for motors and equipment. Make final connections except where noted as "rough-in only" or "final connections by others". Where final connections are to be made by others install outlet box, pull in conductors and leave 8 inches pigtail for each conductor. Conductors shall be taped and appropriate cover plate installed over box.
- B. Furnish safety disconnects for motors and equipment not so equipped, make service complete to each item of equipment.
- C. This section will not be responsible for; internal wiring, alarm wiring, control wiring or interlock wiring for equipment furnished by others or for temperature control wiring, unless such wiring is specifically indicated or called for in other sections of the Project Manual.
- D. Electrical drawings identify the locations of motors and equipment and the motor and equipment wiring schedule provide information based upon the mechanical design. Prior to roughing-in conduit, this section shall consult with Mechanical Contractors, Equipment Contractors and Architect, and shall verify with them the exact locations for rough-ins, and the exact size and characteristics of the services required, and shall obtain from the Mechanical and Equipment Contractors and the Owner a schedule of electrical loads for the equipment furnished by them. These schedules shall be used for verifying services, motor starters, disconnects, fuses, and overload protection.
- E. The Division 15 Contractor and the Division 16 Contractor shall provide written certification that the mechanical equipment requiring power and the electrical equipment providing this power have been coordinated and are totally compatible. The certification shall be submitted to the Architect and the Owner's Representative prior to energizing any mechanical equipment.
- F. The Division 16 Contractor shall submit written acknowledgement of having received and reviewed shop drawing information from the Division 15 Contractor and other parties supplying equipment requiring power. This acknowledgement shall be submitted to the Architect and the Owner's Representative prior to submitting shop drawings for electrical equipment providing power to mechanical or other equipment. Submittals for such items that do not include evidence of having been coordinated will be returned to the Contractor without being reviewed.

END OF SECTION 16660

**SECTION 16741
COMMUNICATIONS CONDUIT SYSTEMS**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Conduit and outlet box systems for installation of voice, data, alarm, security, video and miscellaneous low voltage system wiring and outlets.

PART 2. PRODUCTS

2.1. PRODUCTS

- A. Communication conduit and box systems shall meet same basic requirements as SECTION 16111.
- B. Communications outlet boxes shall be 4-1/16 inches square outlet boxes with one-gang plaster ring.

PART 3. EXECUTION

3.1. INSTALLATION

- A. Install conduit and boxes per Section 16111.
- B. Install outlets for wall mounted telephones at 60 inches above finished floor.
- C. Install pull wire in all empty communications conduit.

END OF SECTION 16741

**SECTION 16744
STRUCTURED WIRING SYSTEM**

PART 1. GENERAL

1.1. SECTION INCLUDES

- A. Furnish and install Voice/Data Cabling. Backbone and Horizontal cabling comprised of Copper Cabling, and support systems and equipment.
- B. The Horizontal (workstation) Cabling System shall consist of 4-pair Unshielded Twisted Pair (UTP) category 6 Copper Cables to each outlet unless otherwise noted for specific locations. The cables shall be installed between each outlet and the indicated room, and routed to the appropriate patch panel serving that area and terminated.
- C. All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the Contractor.
- D. Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types shall be as indicated on the Construction Drawings.

1.2. REGULATORY REFERENCES:

- A. All work and materials shall conform to the rules and requirements of the National Fire Protection Association, the local Electrical Code and present manufacturing standards.
- B. All materials shall be UL Listed and shall be marked as such. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.
- C. All materials shall be ETL Verified (not just tested) to be category 6 component and channel compliant.

1.3. APPROVED CONTRACTOR

- A. THE TELECOMMUNICATIONS CONTRACTOR MUST BE CERTIFIED TO AN EQUIVALENT TO AN APPROVED ORTRONICS CERTIFIED INSTALLER AND BERK-TEK CERTIFIED INTEGRATOR. SUBMIT A COPY OF CERTIFICATION DOCUMENTS. THE CONTRACTOR IS RESPONSIBLE FOR WORKMANSHIP AND INSTALLATION PRACTICES IN ACCORDANCE WITH THE ORTRONICS CI/CIP PROGRAM AND BERK-TEK OASIS PROGRAM. THE COPPER INSTALLATION AND TERMINATION CREW MUST BE CERTIFIED BY BICSI, BERK-TEK, OR ORTRONICS WITH A TECHNICIANS LEVEL OF TRAINING.

1.4. APPROVED PRODUCTS

- A. Approved 4-pair UTP Cable: Berk-Tek Category 6 Cable (Non-Plenum).
- B. Approved UTP connector product manufacturer: Ortronics
- C. Approved Patch Panel manufacturer: Ortronics

1.5. WORK INCLUDED

- A. FURNISH ALL LABOR, EQUIPMENT, MATERIALS, AND SUPPLIES AND PERFORMING ALL OPERATIONS NECESSARY TO COMPLETE THE INSTALLATION OF THIS STRUCTURED CABLING SYSTEM IN COMPLIANCE WITH THE SPECIFICATIONS AND DRAWINGS. THE CONTRACTOR WILL PROVIDE AND INSTALL ALL OF THE REQUIRED MATERIAL TO FORM A COMPLETE SYSTEM WHETHER SPECIFICALLY ADDRESSED IN THE TECHNICAL SPECIFICATIONS OR NOT.
- B. THE WORK SHALL INCLUDE, BUT NOT BE LIMITED TO THE FOLLOWING:
 - 1. Furnish and install a complete voice/data wiring infrastructure.
 - 2. Furnish, install, and terminate all UTP cable
 - 3. Furnish and install all wall plates, jacks, and patch panels.
 - 4. Furnish and install all required cabinets and/or racks as required and as indicated.
 - 5. Furnish any other material required to form a complete system.
 - 6. Perform link or channel testing (100% of horizontal and/or backbone links/channels) and certification of all components.

7. Furnish test results of all cabling to the owner on disk and paper format, listed by each closet, then by workstation ID.
8. Adhere and comply with all requirements of Ortronics CI/CIP and/or Berk-Tek OASIS programs.
9. Provide owner training and documentation.
10. Provide testing documentation and As-built drawings.

1.6. SUBMITTALS

- A. Submit copies of the certification of the company and names of staff that will be performing the installation and termination of the installation to provide proof of compliance with this specification.
- B. Submit proof from manufacturer of contractor's good standing in manufacturer's program.
- C. Submit appropriate cut sheets and samples for all products, hardware and cabling.

1.7. QUALITY ASSURANCE

- A. The telecommunications contractor shall be a company specializing in communication cabling installation.

1.8. DELIVERY, STORAGE AND HANDLING

- A. Delivery and receipt of products shall be at the site.
- B. Cable shall be stored according to manufacturer's recommendations as a minimum. In addition, cable must be stored in a location protected from vandalism and weather. If cable is stored outside, it must be covered with opaque plastic or canvas with provision for ventilation to prevent condensation and for protection from weather. If air temperature at cable storage location will be below 40 degrees F., the cable shall be moved to a heated (50 degrees F. minimum) location. If necessary, cable shall be stored off site at the contractor's expense.

1.9. DRAWINGS

- A. It shall be understood that the electrical details and drawings provided with the specification package are diagrammatic. They are included to show the intent of the specifications and to aid the telecommunications contractor in bidding the job. The telecommunications contractor shall make allowance in the bid proposal to cover whatever work is required to comply with the intent of the plans and specifications.
- B. The telecommunications contractor shall verify all dimensions at the site and be responsible for their accuracy.
- C. Prior to submitting the bid, the telecommunications contractor shall call to the attention of the Architect/Engineer any materials or apparatus the telecommunications contractor believes to be inadequate and to any necessary items of work omitted.

PART 2. PRODUCTS

2.1. MATERIALS

- A. Faceplates, jacks, patch panels, and cabinets shall be manufactured by Ortronics or Engineer approved equal.
- B. All copper cable products shall be manufactured by Berk-Tek or Engineer approved equal.

2.2. TELECOMMUNICATIONS OUTLETS

- A. Cables shall each be terminated at the telecommunications outlets in the connector types described in the subsections below. Included are modular telecommunication jacks. These connector assemblies shall snap into a faceplate.
- B. The Telecommunications Outlet Assembly shall accommodate:
 1. A minimum of two (2) modular jacks
 2. Additional accommodations for specific locations as noted in the plans for additional copper cables as necessary
 3. A blank filler will be installed when extra ports are not used.
 4. A dust cap shall be provided on all modular jacks with the circuit number on the identifier strip.
 5. Multiple jacks that are identified in close proximity on the drawings (but not separated by a physical barrier) may be combined in a single assembly. The telecommunications contractor shall be responsible for determining the optimum compliant configuration based on the products proposed.

6. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation. Prior to installation, the telecommunications contractor shall submit the proposed configuration for each outlet assembly for review by the Owner.
 7. The modular jack shall incorporate printed label strip on the dust cap module for identifying the outlet. Printed labels shall be permanent and compliant with ANSI/TIA/EIA-606-A standard specifications. Labels shall be printed using Ortronics label program (LabelMo) or using a printer such as a Brady hand held printer. Hand printed labels shall not be accepted.
- C. Faceplates: The faceplates shall:
1. Be Ortronics TracJack or Series II style as appropriate to fit the modular jack used
 2. Be UL listed and CSA certified.
 3. Be constructed of high impact, ABS plastic UL 94V-0 construction (except where noted otherwise).
 4. Shall match the faceplate color used for duplex receptacles.
 5. Be compliant with the above requirements along with the following when incorporating optical fiber:
 - a) Be a low profile assembly,
 - b) Incorporate a mechanism for storage of cable and fiber slack needed for termination,
 6. Be available as single-gang or dual-gang.
 7. Shall provide easy access for adds, moves, and changes by front removal of jack modules.
 8. Possess recessed designation windows to facilitate labeling and identification.
 9. Shall include a clear plastic cover to protect labels in the designation window.
 10. Have mounting screws located under recessed designation windows.
 11. Comply with ANSI/TIA/EIA-606-A work area labeling standard.
 12. Allow for the UTP modules to be inverted in place for termination purposes.
 13. Be manufactured by an ISO 9001 registered company.
- D. Voice / Data Jacks
1. Voice/Data jacks shall be 8-position modular jacks and shall be Category 6e or higher performance as defined by the references in this document including ANSI/TIA/EI-568-B.2. All pair combinations must be considered, with the worst-case measurement being the basis for compliance. Modular jack performance shall be third-party verified by a nationally recognized independent testing laboratory.
 2. Dust covers shall be used on each termination.

2.3. MODULAR PATCH PANELS

A. The modular patch panel shall be equal to the following:

Part Number	Description
OR- PHD6E 6U24	24 port, high density, 6 port modules
OR- PHD6E 6U48	48 port, high density, 6 port modules
OR- PHD6E 6U96	96 port, high density, 6 port modules
OR- PSD6E 6U12	12 port, standard density, 6 port modules
OR- PSD6E 6U24	24 port, standard density, 6 port modules
OR- PSD6E 6U48	48 port, standard density, 6 port modules
OR- PSD6E 6U96	96 port, standard density, 6 port modules
OR- PHD6E 8U24	24 port, high density, 8 port modules
OR- PHD6E 8U48	48 port, high density, 8 port modules
OR- PHD6E 8U96	96 port, high density, 8 port modules

2.4. RACKS

A. Wall Mounted Racks

1. Wall mount rack shall:
 - a. Provide the necessary strain relief, bend radius and cable routing for proper installation of high performance cross connect products, meeting all specifications of ANSI/TIA/EIA-568-B.
 - b. Have top cable trough to route patch and distribution cables between racks.
 - c. Have EIA hole pattern on front and rear.
 - d. Rack height shall be specified as 7 ft (44 rack units) or 4.0 ft (22 rack units).
 - e. Be available with a 6.5 inches or 14 inches channel depth.
 - f. Be available with hook and loop straps for securing cables inside the vertical U-channels.
 - g. Be available with vertical cable management rings for cord routing organization and strain relief.
 - h. Be available with vertical U-channels to protect and conceal distribution cables.
 - i. Provide floor and ceiling access for cable management and distribution.
 - j. Have wall mount braces with locator posts for easy wall mounting.
 - k. Have side access points that allow for access to manage/install distribution cables in the vertical channels.
 - l. Be available in standard color of black.
 - m. Be manufactured by an ISO 9001 registered company.

2.5. HORIZONTAL DISTRIBUTION CABLE

- A. All horizontal data station cable and voice cable shall terminate on modular patch panels, in the indicated respective Telecommunications Room or Equipment Room as specified on the drawings.
- B. 100 Ohm Enhanced Category 6 Unshielded TWISTED PAIR (UTP) CABLE
 - 1. Physical Characteristics:
 - a. Shall meet applicable requirements of ANSI/ICEA S-80-576. All 4 pairs must be insulated with F.E.P.

2.6. GROUNDING AND BONDING

- A. Ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor.
- B. Each Voice/Data room shall be equipped with a grounding bus bar. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.
- C. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. shall be grounded to the respective grounding bus bar using a minimum #6 AWG stranded copper bonding conductor and compression connectors.
- D. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape.

2.7. FIRESTOP

- A. A firestop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.
- B. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly firestopped.
- C. Firestop systems shall be UL Classified to ASTM E814 (UL 1479) and shall be approved by a qualified Professional Engineer (PE), licensed (actual or reciprocal) in the state where the work is to be performed. A drawing showing the proposed firestop system, stamped/embossed by the PE shall be provided to the Owner's Representative prior to installing the firestop system(s).

PART 3. - EXECUTION

3.1. WORK AREA OUTLETS

- A. Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturer's bend radius. In hollow wall installations where box-eliminators are used, excess wire can be stored in the wall. No more than 12 inches of UTP slack shall be stored in an in-wall box, modular furniture raceway, or insulated walls. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
- B. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B.1 document, manufacturer's recommendations and best industry practices.
- C. Pair untwist at the termination shall not exceed one-half inch.
- D. Bend radius of the horizontal cable shall not be less than 4 times the outside diameter of the cable.
- E. The cable jacket shall be maintained to within one inch of the termination point.

3.2. HORIZONTAL DISTRIBUTION CABLE INSTALLATION

- A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.

- B. A pull cord (nylon; 1/8 inches minimum) shall be co-installed with all cable installed in any conduit.
 - C. Cable raceways shall not be filled greater than the TIA/EIA-569-A maximum fill for the particular raceway type or 40%.
 - D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.
 - E. Where transition points, or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.
 - F. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
 - G. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.
 - H. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.
 - I. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
 - J. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.
 - K. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.
 - L. Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
 - M. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.
 - N. Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a four-pair UTP cable.
- 3.3. HORIZONTAL CROSS CONNECT INSTALLATION
- A. Cables shall be dressed and terminated in accordance with the recommendations made in the TIA/EIA-568-B standard, manufacturer's recommendations and best industry practices.
 - B. Pair untwist at the termination shall not exceed 0.5 inch.
 - C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.
 - D. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
 - E. The cable jacket shall be maintained as close as possible to the termination point.
 - F. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.
- 3.4. BACKBONE CABLE INSTALLATION
- A. Backbone cables shall be installed separately from horizontal distribution cables
 - B. A pull cord (nylon; 1/8 inches minimum) shall be co-installed with all cable installed in any conduit.
 - C. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits
 - D. Where backbone cables are installed in an air return plenum, riser rated cable shall be installed in metallic conduit.

- E. Where backbone cables and distribution cables are installed in a cable tray or wireway, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.

3.5. COPPER TERMINATION HARDWARE

- A. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-B standard, manufacturer's recommendations and best industry practice.
- B. Pair untwist at the termination shall not exceed one-half inch.
- C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.
- D. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- E. The cable jacket shall be maintained to within one inch of the termination point.
- F. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.6. FIRESTOP SYSTEM

- A. All firestop systems shall be installed in accordance with the manufacturer's recommendations and shall be completely installed and available for inspection by the local inspection authorities prior to cable system acceptance.

3.7. IDENTIFICATION AND LABELING

- A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the successful contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets and follow the guidelines set forth in TIA/EIA-606-A. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.
- B. All label printing will be machine generated by Ortronics LabelMo software using indelible ink ribbons or cartridges. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.

3.8. TESTING AND ACCEPTANCE

A. General

- 1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-B (B.1, B.2, B.3) and Ortronics Certification Program Information Manual. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
- 2. All cables shall be tested in accordance with this document, the ANSI/TIA/EIA standards, the Ortronics Certification Program Information Manual and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

B. Copper Channel Testing

- 1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Horizontal cabling shall be tested using a level IIE or better test unit for category 6 compliance.
- 2. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs.

Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.

3. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA-568-B Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.
4. Category 6 Performance

Follow the Standards requirements established in:

- ANSI/TIA/EIA-568-B .1

A level IIE or better test unit is required to verify category 6 performance.

The basic tests required are:

- Wire Map
- Length
- Attenuation
- NEXT (Near end crosstalk)
- Return Loss
- ELFEXT Loss
- Propagation Delay
- Delay skew
- PSNEXT (Power sum near-end crosstalk loss)
- PSELFEXT (Power sum equal level far-end crosstalk loss)

3.9. SYSTEM DOCUMENTATION

- A. Upon completion of the installation, the telecommunications contractor shall provide three (3) full documentation sets to the Engineer for approval. Documentation shall include the items detailed in the sub-sections below.
- B. Documentation shall be submitted within ten working days of the completion of each testing phase (e.g. subsystem, cable type, area, floor, etc.). This is inclusive of all test result and draft as-built drawings. Draft drawings may include annotations done by hand. Machine generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase. At the request of the Engineer, the telecommunications contractor shall provide copies of the original test results.
- C. The Engineer may request that a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the telecommunications contractor, additional testing can be requested to the extent determined necessary by the Engineer, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

3.10. TEST RESULTS

- A. Test documentation shall be provided on disk within three weeks after the completion of the project. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an

annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

- B. The field test equipment shall meet the requirements of ANSI/TIA/EIA-568-B including applicable TSB's and amendments. The appropriate level IIE tester shall be used to verify Category 5e cabling systems.
 - C. Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. The telecommunications contractor must furnish this information in electronic form.
 - D. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.
- 3.11. RECORD DRAWINGS
- A. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (DWG, AutoCAD rel. 14) formats on which as-built construction information can be added. These documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner.
 - B. The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD) form.
- 3.12. WARRANTY
- A. An Product Warranty shall be provided which warrants functionality of all components used in the system for 1 year from the date of registration. The Product Warranty shall warrant the installed horizontal and/or backbone copper.
 - B. The Application Assurance Warranty shall cover the failure of the wiring system to support the applications that are designed for the link/channel specifications of TIA/EIA 568B. These applications include, but are not limited to, 10BASE-T, 100BASE-T, 1000BASE-T, and 155 Mb/s ATM.
 - C. The contractor shall provide a warranty on the physical installation.
- 3.13. CONTINUING MAINTENANCE
- A. The contractor shall furnish an hourly rate with the proposal submittal, which shall be valid for a period of one year from the date of acceptance. This rate will be used when cabling support is required to affect moves, adds, and changes to the system (MACs). MACs performed by the Ortronics CIP Contractor / Berk-Tek OASIS Integrator shall be added to the NetClearGT warranty when registered with Ortronics or Berk-Tek.
- 3.14. FINAL ACCEPTANCE & SYSTEM CERTIFICATION
- A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation, and successful performance of the cabling system for a two week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, the end user shall be provided with a numbered certificate, from Ortronics or Berk-Tek, registering the installation.

END OF SECTION 16764